"PREVALENCE OF DENTAL FLUOROSIS AND DENTAL CARIES IN RELATION TO FLUORIDE IN DRINKING WATER AMONG 13-15 YEAR OLD SCHOOL GOING CHIDREN OF MELUR BLOCK, MADURAI DISTRICT"

A dissertation submitted

In partial fulfillment of the requirements

For the degree of

MASTER OF DENTAL SURGERY

BRANCH VII

PUBLIC HEALTH DENTISTRY

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

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I hereby declare that this dissertation titled "**PREVALENCE OF DENTAL FLUOROSIS AND DENTAL CARIES IN RELATION TO FLUORIDE IN DRINKING WATER AMONG 13-15 YEAR OLD SCHOOL GOING CHILDREN OF MELUR BLOCK, MADURAI DISTRICT**" is a bonafide and genuine research work carried out by me under the guidance of **DR.TARANATH.M, M.D.S., Reader,** Department of Public Health Dentistry, Best Dental Science College, Madurai - 625104.

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DURATION OF THE COURSE	**3 YEARS**
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This agreement herein after the "Agreement" is entered into on this day 29/ 11/2017, between the Best Dental Science College represented by its **Principal** having address at Best Dental Science College, Madurai – 625104, (hereafter referred to as, 'the College') And

Dr.TARANATH.M, aged 35 years working as **Reader** in Department of Public Health Dentistry at the College, having residence address at Room no 1, staff quarters, Best Dental Science College, Madurai- 625 104 And

Dr.PRATHAP.R aged 28 years currently studying as **Post Graduate student** in Department of Public Health Dentistry, Best Dental College, Madurai- 625104 (herein after referred to as the 'Principal Investigator'

Whereas the PG/Research student as part of her curriculum undertakes to research on "**Prevalence of dental fluorosis and dental caries in relation to fluoride in drinking water among 13-15 year old school going children of Melur block, Madurai district**" for which purpose PG/Principal Investigator shall act as Principal Investigator and the college shall provide the requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Co-investigator.

Whereas the parties, by this agreement have mutually agreed to the various issues including in particular the copyright and confidentiality issues that arise in this regard.

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9. If any dispute arises as to the matters related or connected to this agreement herein, it shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act 1996.

In witness whereof the parties herein above mentioned have on this day, month and year herein above mentioned set their hands to this agreement in the presence of the following two witnesses.

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CONTENTS

Introduction

Natural wellbeing involves those parts of human wellbeing including personal satisfaction that are dictated by physical, organic, social and mental factors in the earth. The connection between nature and its effect on human wellbeing is very intricate. The family unit, work environment, open air and indoor conditions may posture dangers to wellbeing in various diverse ways. The low quality of air which we may inhale, the sullied water we may drink and the surroundings in which we live, decide our personal satisfaction. While the hereditary elements may likewise be in charge of causing maladies however the ecological variables assume significantly more dynamic part in contracting different infections.[1]

Water is a basic common asset for maintaining life and a critical piece of our condition. New water that we utilize originates from two sources via surface water and ground water.[2] Though surface water sources have satisfied the water requirements for quite a while, by and by with continuous elimination of surface water sources because of the relentlessly expanding use, ground water sources are looked upon as the promising alternatives.[3]

Groundwater, constituting 97% of worldwide freshwater and utilized for drinking by over half of the total populace, fills in as the main financially suitable choice for some groups of population.[4]

Groundwater shapes a noteworthy wellspring of savoring water urban and additionally in country territories. This is consistent with a more prominent degree on account of creating nations like India where an expected 80% of local utilization in rustic and half in urban territories are met by groundwater sources alone.4 More than 90% of the country populace utilizes groundwater for household purposes.[5] Because of different anthropogenic and normal components combined with aimless "mining",

the quality and amount of groundwater have dwindled to alarmingly low levels. In this way, notwithstanding shortage, the passage of geogenic toxins like fluoride and arsenic into groundwater has turned into the most critical and testing natural issue the world over, particularly in creating countries.[4]

In India almost 74% of populace lives in towns and don't have an entrance for brought together funneled water supply. Henceforth they acquire water by penetrating wells.[6] The issue of high fluoride in groundwater has now turned out to be a standout amongst the most vital toxicological and geo ecological issues in India.[7]

Dissolution or weathering of rocks and soils, dissolving of lime, gypsum and other salt sources, mining activities, industrial activities, agricultural activities and geological formations of area etc., carries available minerals to and percolates with rainwater and joins the ground water. Some of the commonly occurring constituents are calcium, magnesium, sodium, potassium, iron, manganese, arsenic, nitrate, chlorides, fluoride, bicarbonate etc. Presence of these ions in excess of permissible limits, as prescribed by IS 10500 & WHO in 1983, results in undesirable health effect.[3]

Some elements are essential in trace amount for human being while higher concentration of the same can cause toxic effects. Fluoride is one of them. Due to rapid urbanization and growth of modern industries (anthropogenic source of fluoride) as well as geo chemical dissolution of fluoride bearing minerals (natural source of fluoride), fluoride concentration is increasing in the environment including water resources.[7] Among various ions present fluoride is one such that is present in ground water. Fluoride is a salt of an element called fluorine. Fluorine is the most highly reactive element of halogen family.[3]

The government enlist of United States Food and Drug Administration portrays fluoride as a basic component. The WHO master board of trustees on follow components has included fluorine as one among the 14 physiologically basic components required for the typical development and improvement of the body.8 Fluorides have certain physiological properties of awesome enthusiasm for connection to human wellbeing and prosperity. Fluoride has double significance.[8] Fluoride is regularly depicted as a 'twofold edged sword' as deficient ingestion is related with dental caries, where as exorbitant admission prompts dental, skeletal and delicate tissue fluorosis which has no cure.[9]

Fluoride being a profoundly electronegative component tends to get pulled in by decidedly charged particles like calcium. Consequently the impact of fluoride on mineralized tissues like bone and teeth prompting formative rotations is of clinical essentialness as they have most astounding measure of calcium and in this manner draw in the greatest measure of fluoride that gets saved as calcium– fluorapatite crystals.[10]

Fluoride discovers its way in to human body to a great extent through the drinking water and causes fluoride poisonous quality influencing bones and teeth. Endemic dental fluorosis is an unsettling influence of tooth development caused by unnecessary admission of fluoride amid the developmental time of dental polish (amelogenesis).[6] Tooth finish is made mainly out of crystalline hydroxylapatite. Under ordinary conditions, when fluoride is available in water supply, the greater part of the ingested fluoride particles get fused into the apatite precious stone cross section of calciferous tissue finish amid its arrangement. The hydroxyl ions gets substituted by fluoride particle since fluorapatite is more steady than hydroxyapatite. Consequently, a lot of fluoride gets bound in these tissues and just a little sum is

discharged through sweat, pee and stool. The force of fluorosis isn't only reliant on the fluoride content in water, yet additionally on the fluoride from different sources, physical action and dietary habits.[10] Fluoride inebriation relies on the sum, frame and recurrence of fluoride ingestion, the length, bioavailability of fluoride compound and hereditary variations.[6]

Around 200 million individuals from 25 countries have wellbeing dangers in view of high fluoride in ground water.[11] The most recent data demonstrates that fluorosis is endemic in no less than 25 nations over the world. Known fluoride belts ashore include: one that extends from Syria through Jordan, Egypt, Libya, Algeria, Sudan, Kenya and Tanzania, and another that extends from Turkey through Iraq, Iran, Afghanistan, India, Northern Thailand and China. There are comparable belts in the America and Japan.[9] Two most populated nations of the world, China and India, remain at the best in the rundown of most exceedingly awful hit countries in groundwater sullying with fluoride.[4]

India is among the numerous nations on the planet; where high fluoride sullied ground water is making wellbeing perils. Safe savoring water rustic ranges of India is dominatingly reliant on groundwater sources, which are profoundly debased with fluoride.[12] The issue of over the top fluoride in groundwater in India was first detailed in 1937 in the State of Andhra Pradesh. In India, around 62 million individuals including 6 million youngsters experience the ill effects of fluorosis in light of utilization of water with high fluoride concentrations.[5] Fluorosis is an endemic condition pervasive in 337,690,000 populaces dwelling in 390,000 towns in 22 of the 32 conditions of India. The most truly influenced states are Andhra Pradesh, Punjab, Haryana, Rajasthan, Gujarat, Uttar Pradesh, Bihar, Tamil Nadu, Kerala, Karnataka and Maharashtra.[13]

In Tamil Nadu, the high convergence of fluoride in groundwater is observed to be in Dharmapuri and Salem area intently took after by Coimbatore, Madurai, Trichy, Dindigul and Chidambaram region. The areas having low fluoride are Thirunelveli , Pudukottai , North Arcot , and Ramnad.

Geogenic factors are in charge of large amounts of fluoride in groundwater in the Madurai. The higher centralization of fluoride is seen in the Charnockite rocks which lies in the northern part (Melur) of the area propose that there is the lithological control in the appropriation of fluorides. The pH assumes a crucial part in the disintegration and draining of fluoride into the groundwater.[14] Based on this data an investigation was intended to discover the Prevalence of dental fluorosis and dental caries in connection to fluoride in drinking water among 13-15 year old fashioned going offspring of Melur taluk of Madurai.

AIM

To assess the prevalence of dental fluorosis, dental caries experience and it's relation to fluoride in drinking water among 13-15 year old school going children in Melur block of Madurai district, Tamil Nadu.

The objectives were:

- To estimate the level of fluoride in drinking water in villages in Melur block of Madurai district, Tamil Nadu.

- To assess the prevalence of dental fluorosis among 13-15 year old school children in Melur block of Madurai district, Tamil Nadu.

- To assess the dental caries experience among 13-15 year old school children in Melur block of Madurai district, Tamil Nadu.

- To assess the relationship between the prevalence of dental fluorosis and fluoride in drinking water among 13-15 year old school going children in Melur block of Madurai district, Tamil Nadu.

- To assess the relationship between the prevalence of dental caries experience and fluoride in drinking water among 13-15 year old school going children in Melur block of Madurai district, Tamil Nadu.

- To assess the relationship between dental fluorosis and dental caries experience among 13-15 year old school going children in Melur block of Madurai district, Tamil Nadu.

Reddy VVS and Tewari A (1992)[15] conducted a study to determine the prevalence of dental caries in different levels of fluoride in drinking water. An epidemiological study was carried out on 1759 children in the age group of 12- 17 years from the six specific rural areas from endemic fluoride areas of district – Bhatinda, Punjab to analyze the relationship between dental caries and its severity at different levels of fluoride in drinking water. Maximum caries reduction with minimum amount of esthetically objectionable enamel mottling occurred in the area having 1.10 ppm in drinking water. Level of fluoride of about 0.90 ppm or 1.0 ppm in drinking water appears to be optimum where maximum caries protection can be achieved with minimum of enamel mottling.

Reddy VVS et al (1993)[16] carried out an systematic investigation in six endemic areas of Karnataka to study the relationship of the prevalence and severity of enamel mottling with different levels of fluoride in drinking water. Examination was carried out among 1414 school children aged 12-17 years belonging to Chitradurga, Bellary and Dharwad district of Karnataka, India. The study was concluded that as the fluoride levels in drinking water increased from 1.10 to 11.00 ppm fluoride, the prevalence of moderately severe and severe grades of enamel mottling increased gradually.

Keith E. Heller (1997)[17] conducted a study to investigate the relationships between caries experience and dental fluorosis at different fluoride concentrations in drinking water. The impact of other fluoride products also was assessed. This study used data from the 1986-87 National Survey of US school children. Fluoride levels

of school water were used as an indicator of the children's water fluoride exposure. Data from this study suggest that are consideration of the policies concerning the most appropriate concentrations for water fluoridation might be appropriate for the United States.

Gopalakrishnan P et al (1999)[18] conducted a study to assess the prevalence of dental fluorosis among school children in the Ambalappuzha taluk of Alappuzha district of Kerala and to examine the associations of the condition with potential risk factors. The prevalence of dental fluorosis was higher among children who consumed pipe water as compared to children who consumed well water which is been 44.8% and 12.7% respectively ($p<0.001$).

Menon A and Indhushekar KR (1999)[19] conducted a study to investigate and compare the dental effects of naturally occurring low (0.5 ppm) and high levels (1.2 ppm) of fluoride on school children aged 6-16 years. A total of 3605 students in low fluoride areas (Dharwad) and 3618 students in high fluoride areas (Gadag) were examined. The study was concluded that there was a decrease in the prevalence of dental caries with the increase in level of fluoride in drinking water and the correlation between them was found to be statistically significant.

Grobler SR et al (2001)[20] conducted a study to determine the relationship between caries experience, degree of fluorosis and different concentration of fluoride in drinking water for children of age group 10 -15 years, who lived continuously since birth in 3 different naturally fluoridated areas (Leeugamka 3.0, Kuboes 0.48 and

Sandriff 0.19 ppm fluoride), with virtually no dental care or any fluoride therapy. Thus the result of the study suggest a positive association between high fluoride levels in drinking water and dental caries.

Budipramana ES et al (2002)[21] conducted a study to determine the prevalence and severity of dental fluorosis and dental caries in the sub district of Asembagus which is an fluorosis endemic area, with fluoride content in drinking water ranging from 0.51 to 3.15 ppm. There was no significant linear relationship between fluoride content in drinking water and dental caries in permanent teeth (DT) or dental caries in primary teeth (dt) but a positive correlation with CFI was found to exist. There was significant difference (p= 0.000) in CFI between the village groups but there was no correlation between dental caries in permanent teeth (DT), dental caries in primary teeth (dt) and CFI (p= 0.689).

Chandra Shekar J et al (2002 -2003)[22] conducted a study to assess the prevalence and degree of dental fluorosis in 12 to 15 years old school going children. A total of 1131 school children in age group of 12 to 15 years old participated in the study. The prevalence and severity of dental fluorosis was directly proportional to level of drinking water concentration in the drinking water.

Acharya S and Anuradha KP (2003)[23] conducted a study to assess the prevalence of dental caries and its correlation with fluoride in the drinking water in Davangere district, Karnataka, India. The study was concluded that although dental caries was

negatively associated with increasing fluoride levels, the problem of attendant dental fluorosis should also be considered seriously.

Al Dosari AM et al (2004)[24] conducted a cross sectional study to determine the dental caries prevalence and severity among primary and intermediate school children in Riyadh and Qaseem regions of Saudi Arabia and to determine any correlation between dental caries and fluoride levels in drinking water. The author concluded that the caries experience among the primary and intermediate school children in Riyadh and Qaseem was very high and there was no linear correlation between water fluoride level and caries experience in these children.

Wondwossen F et al (2004)[25] conducted a study to assess the relationship between dental caries and dental fluorosis in Ethiopian children living in Rift valley areas which was known for endemic fluorosis . Thus, it was concluded that a positive relationship between dental caries and dental fluorosis was observed across various tooth types in both areas.

Acharya S (2005)[26] conducted a study to assess the prevalence of dental caries and dental fluorosis in areas with different levels of fluoride in drinking water and to establish the surface susceptibility of dental caries in Davangere region an endemic fluoride area. Dental caries showed a declining trend with increasing level of fluoride in drinking water. Highly significant negative correlation ($r = -0.16$) was observed between water fluoride levels and dental caries in this study.

Nagarajappa S and K.V.V Prasad (2006)[27] conducted a study to assess the dental caries and dental fluorosis experience among 5-6 and 12-13 years old in Gadag city. 5-6 years and 12-13 years school children were selected for the study using stratified random sampling technique. Study population in Gadag and comparison group was 226 and 195 respectively. The author had concluded that there was significantly less caries experience among 12-13 years old in Gadag compared to the comparison group of places. The 12-13 year old children in Gadag were experiencing fluorosis even after the change of drinking water source to Tunga-bhadra river water.

Manjunath R and Hiremath S.S (2007)[28] conducted a study to assess the relationship between naturally occurring different levels of fluoride in drinking water with caries and enamel defects including dental fluorosis among urban and rural school going children of age 6 -14 years in Tumkur district in Karnataka. The author had conducted a study on 1616 school children who were permanent residents of that region and were interviewed and examined. Hence the severity of dental fluorosis increased as the level of fluoride in drinking water increased.

Pontigo-Loyola AP et al (2007)[29] conducted a study to determine the experience, prevalence and severity of dental caries in adolescents naturally exposed to various fluoride concentrations. A cross sectional census was conducted on 1,538 adolescents of age 12 and 15 years living at high altitude above sea level (> 2,000 m or >6, ft) in above- optimal fluoridated communities of Hidalgo, Mexico. The author concluded that fluoride exposure does not appear to be

reducing the caries prevalence (DMFT> 0) or caries severity (DMFT ≥ 4) in these high altitude communities.

América P. Pontigo-Loyola et al (2008)[30] conducted a study to determine the prevalence and severity of dental fluorosis in Mexican adolescents. The overall Community Fluorosis Index was found to be 1.85. It was concluded that a relationship between fluoride concentration in water in each community and fluorosis was observed.

Dobaradaran S et al (2008)[31] conducted a study to determine the relationship between ground water fluoride (F) concentration and dental caries in children living in the Dashtestan area of Busheshr province in Iran. A total of 2340 children in the age group of 6-11 were examined for the study. The fluoride concentration in drinking water the 14 villages ranged from 0.99 to 2.50 mg/L. The result of the study showed that there is no significant correlation between fluoride content of the water with dental caries in permanent teeth and dental caries in primary teeth in these 14 villages. But when the village with highest water fluoride level (Khun – 2.50 mg F/L) and the lowest caries scores (mean DT of 0.015 and mean dt of 0.02) was omitted a direct but weak linear correlation between increasing fluoride content of drinking water and increasing dental caries in both permanent and deciduous teeth (DT (R2 = 0.2704) and dt (R2 = 0.257)) was observed in the remaining 13 villages.

Baskaradoss JK et al (2008)[32] conducted a study to determine the prevalence and severity of dental fluorosis in 11-15 year old school children of Kanyakumari

district, Tamil Nadu and the relationship between prevalence of dental fluorosis and selected risk factors. A stepwise increase in the prevalence of dental fluorosis was noted with a corresponding increase in the fluoride content of the drinking water from 1.5 – 1.7 ppm in the various blocks of the district and a statistically significant inverse association between the caries status and the prevalence of dental fluorosis was observed.

Abdullah M. Aldosari et al (2010)[33] investigated a study to correlate fluoride levels in drinking water sources with caries experience and dental fluorosis in Saudi Arabia, and suggest appropriate fluoride concentration for drinking water in the country. The author concluded the study that fluoride levels in drinking water sources in Saudi Arabia correlate significantly with caries experience and prevalence of dental fluorosis and suggest 0.6 ppm as appropriate fluoride concentration for drinking water in Saudi Arabia.

Srinivas and Sudhakar (2010)[34] conducted a study to assess the relationship between dental caries and dental fluorosis in seven villages of Chintakanimandal, Khamman district. They examined 402 children between the age group of 14- 16 years, selected from areas with 0.8 ppm to 2.02 ppm fluoride concentration in drinking water. They were examined for dental caries and dental fluorosis using DMFT system and Dean's fluorosis index. Prevalence of dental fluorosis was found to be 14.2% at 0.8 ppm and 55.14% at 2.02 ppm. The corresponding caries prevalence and mean DMFT in areas with 24.4% versus 43.1%, and 0.4 versus 1 respectively. The author concluded that dental caries increased with increasing

severity of dental fluorosis and they observed a positive relationship between dental caries and dental fluorosis.

Chandrashekar B.S et al (2011)[6] conducted a cross sectional study to analyze levels of fluoride in different sources of drinking water and its relation with severity of dental fluorosis among study population of 12-15 year old school going children from selected administrative areas of Kanakapura taluk of Bengaluru rural district. It was concluded that the prevalence of fluorosis in Kanakapura is in negative range of public health concern.

Jitender Solanki et al (2011)[35] conducted a study to know the prevalence of dental fluorosis and the relation of dental fluorosis at varying degree of fluoride concentration in drinking water among the school children of Jodhpur city. The results of the study also indicated that dental fluorosis exists irrespective of levels of fluoride concentration in drinking water in Jodhpur city, Rajastan.

Shwetha K.M and Pushpanjali K (2011)[36] conducted a study to assess the prevalence of dental fluorosis among the school children, to estimate fluoride level in drinking water source in Enjilgere village in Tumkur district known for endemic fluorosis and for comparison of two indices measuring dental fluorosis. It was concluded that increase in fluoride concentration in the drinking water, resulted in increased prevalence of dental fluorosis in this village and TSIF was more sensitive index for assessing dental fluorosis.

Mahantesh et al (2011)[37] conducted a study to find the relationship of fluoride concentration in drinking water supply and prevalence of dental fluorosis in permanent teeth and to find the optimal concentration of fluoride in drinking water in the villages of northern Karnataka, India. They concluded the study that fluoride concentration in drinking water did not have an independent effect on fluorosis. The presence or absence of fluorosis may also attribute due to ingestion of fluoride from other sources in addition to drinking water.

Ranganath S and Naganandini (2011)[38] conducted a cross sectional analytical study among the permanent residents of Markpur mandal, Andrapradesh. The distribution was highly significant for the females in above optimal category and for males in below optimal category with $p<0.0001$. Out of 2100 school children participated in the study, 1786(85.4%) were affected with fluorosis in permanent teeth and the percentage increased as the fluoride levels increased.

Pradnya.V. Kakodkar and Sudarshana D. Pawar (2011)[39] conducted a study to estimate the water fluoride levels and clinically confirm the presence of dental fluorosis and its effect on dental caries. A dental survey was conducted among 303 Amode villagers of whom 138 were males and 165 were females in the age range of 3- 65 years The author concluded that ORALAB test kit was simple, economical and efficient means for colorimetric estimation in field studies. Despite the poor and unfavourable oral hygiene practices, the low caries prevalence can be attributed to the fluoride in water.

Abhay B Mane et al (2011)[40] conducted a cross sectional study among primary school children residing in rural area of Raichur district, Karnataka to assess the prevalence and severity of dental fluorosis and to compute Community Fluorosis Index (CFI). The calculated community fluorosis index (CFI) was found to be 0.44 indicating that the prevalence and severity of dental fluorosis was border line in 4 villages for public health significance in the sample.

Shashi A and Bhardwaj M (2011)[41] conducted a study to determine the relationship between severity of dental fluorosis and exposure to fluoride through drinking water in seven high fluoride areas (HFA 1-7) of Punjab state, India. There was a significant positive dose-response relationship between drinking water fluoride, dental fluorosis, and defect dental fluorosis.

Shekar C et al (2012)[42] conducted a cross sectional study to assess the prevalence and severity of dental fluorosis and dental caries among 12 and 15 years old children in relation to fluoride concentration in drinking water. The author concluded that there was a negative correlation between dental caries and fluoride concentration for the entire study population. However, in high fluoride areas, there was a positive correlation between fluoride concentration and dental caries.

Kiran Kumar Dandi (2012)[43] conducted a study to assess the prevalence of dental caries and dental fluorosis in areas with varying levels of fluoride in their drinking water in Prakasam district of Andhra Pradesh . The author concluded the study that dental caries was found to be insignificant with the socio demographic factors studied in this study as well as to the levels of fluoride in drinking water. Dental fluorosis was directly associated with the fluoride level in drinking water.

Ankur Jain et al (2012)[44] conducted a study to assess point prevalence of dental fluorosis and dental caries and their inter relationship in children of age group 10 to 14 years from areas in Lucknow district. They concluded that dental caries increases with increasing severity of fluorosis in low, moderate and high fluoride areas. They observed a positive relationship between dental caries and dental fluorosis in all three areas.

Ravi Kiran E and Vijaya K (2012)[45] conducted a study to estimate the prevalence and severity of dental fluorosis as well as to compute Community Fluorosis index (CFI) among high school children in a rural area of Nalgonda district, Andhra Pradesh. The calculated CFI of Cherlapally village was found to be 0.73 which was designated as 'slight' public health significance.

P.V. Kotecha et al (2012)[46] carried out the study to measure and compare the prevalence of dental fluorosis and dental caries in the population residing in high and normal level of fluoride in their drinking water in Vadodara district, Gujarat,

India They concluded the study that the risk of dental fluorosis was higher in the areas showing more fluoride content in drinking water and to a lesser degree of dental caries in the same area. High fluoride content is a risk factor for dental fluorosis and problem of dental fluorosis increased with passage of time suggesting that the fluoride content in the water has perhaps increased over time.

Vikas C Desai et al (2013)[47] conducted a study to assess prevalence of dental caries at different water fluoride levels in Nalgonda district of Andhra Pradesh The lowest caries prevalence was found in optimal fluoride areas. There was a positive correlation between severity of dental fluorosis and prevalence of dental caries. There was a negative correlation between fluoride concentration and dental caries. The prevalence of dental caries decreased with increasing concentration of fluoride in the drinking water up to 5 ppm.

Aman Moda and Samir Dutta (2013)[48] conducted a study to assess the prevalence of dental fluorosis and dental caries among 6-12 year old school children of Rewari district, Haryana and the relation between the dental fluorosis and dental caries.A study was conducted among the 6-12 year old school going children of Rewari district, Haryana. The result of the study showed that severity of dental fluorosis increased with increased fluoride levels in drinking water. Dental caries decreased with increase in fluoride concentration. A statistically significant negative correlation ($r = -0.75$) was obtained when fluoride in drinking water was correlated with dental caries. Fluoride proved to be an anti carious agent despite of producing

unacceptable dental fluorosis. So, it can be concluded that there is a high prevalence of mild to severe fluorosis in Rewari district.

Sukhabogi JR et al (2013)[49] conducted a study to determine the prevalence of dental caries and dental fluorosis among 12 and 15 years old school children in relation to fluoride concentration in Nalgonda district. The author concluded based on study results that the fluoride concentration above optimal levels may not give any additional benefits in caries prevention but increase the risk of dental fluorosis.

Prabhu S et al (2014)[50] conducted a study to assess the prevalence of dental caries, dental fluorosis and its relation to fluoride levels in drinking water among 12-15 year old children in Sriperumbudur taluk, Kanchipuram district in India. It was concluded that DMFT scores of the study population decreased with the increase in fluoride levels in drinking water and the prevalence and severity dental fluorosis increased with the increase in fluoride levels of drinking water.

Shanthi M and Reddy BV (2014)[51] conducted a study to assess the relationship between drinking water fluoride (F) levels, dental fluorosis and dental caries among 9-12 years old school children of Nelakondapally mandal, Khammam district, Andhra Pradesh. It was observed that caries prevalence was high in strata 1 with 0.0-0.6 water fluoride concentration, followed by least in optimal water fluoride concentration and caries prevalence was slightly high in strata 3 compared with strata 2. Dental fluorosis increased with increased fluoride levels in drinking water.

Sumeena, Paras Agarwal (2014)[52] conducted a study to determine the prevalence and severity of dental fluorosis in school children of age 7 to 15 years and also to find the association between urinary fluoride levels and dental fluorosis in the same population. The results of the study revealed that the prevalence of dental fluorosis was observed as 65.5% out of which 6.2% had severe fluorosis, 28.4% had moderate fluorosis and 30.9% had mild fluorosis. Community fluorosis index was calculated as 3.5 indicating that dental fluorosis of this region are of high public health importance.

A cross sectional study was carried out among 13-15 year old school going children of Melur block of Madurai district, to assess the prevalence of dental fluorosis, dental caries experience and its relation to level of fluoride in drinking water.

STUDY AREA

Madurai is a major city in the Indian state of Tamil Nadu. It is the administrative headquarters of Madurai District. Madurai is the third largest city in Tamil Nadu, and is the 25th populated city in India and located on the banks of River Vaigai. Madurai city is referred by various names including "Madurai", "Koodal", "Malligai Maanagar", "Naanmadakoodal" and "Thirualavai". The word Madurai may be derived from Madhura (sweetness) arising out of the divine nectar showered on the city by the Hindu God Shiva from his matted hair. Madurai is located at 9.93°N 78.12°E. It has an average elevation of 101 metres. The city of Madurai lies on the flat and fertile plain of the river Vaigai, which runs in the northwest-southeast direction through the city, dividing it into two almost equal halves. Temperatures during summer generally reach a maximum of 40 °C and a minimum of 26.3 °C and winter temperatures range between 29.6 °C and 18 °C. The average annual rainfall for the Madurai district is about 85.76 cm. Madurai lies southeast of the Western Ghats, and the surrounding region occupies the plains of South India and contains several mountain spurs. The soil type in central Madurai is predominantly clay loam, while red loam and black cotton types are widely prevalent in the outer fringes of the city. The city covers an area of 147.97 km^2 and had a population of 1,017,865 in 2011[53]. Madurai district has 3 revenue divisions, 10 taluks, 13 blocks, 9 town panchayats, 420 panchayat villages and 665 villages. Melur block of Madurai district consist of 36 village panchayats and

one town panchayats which was divided into three groups according to level of fluoride in drinking water.[54]

COLLECTION OF WATER SAMPLES

List of village panchayats, town panchayats and their habitations list of Melur block were obtained from the Block Development Officer of Melur Block Development Office. Water samples were collected from 100 Villages of Melur Block. Water samples were collected from the common drinking water source in a clean polyethylene bottles. The bottles were rinsed in distilled water prior to rinsing twice with water to be sampled. The bottles were then filled, closed firmly and clearly coded with permanent ink pen about location of the source of drinking water.

Collected water samples were sent to Department of Chemistry, Gandhi Gram Rural University of Dindigul district for analyzing the levels of fluoride in each sample. As per the requirement the collected samples reached the laboratory within 24 hrs of collection. The fluoride levels in drinking water were analyzed using Thermo Scientific Orion Versa Star – Advanced Electrochemistry meter with Fluoride Ion Selective Electrode BN 9609.

Grouping of levels of fluoride in drinking water

The classical studies of Dean et al conducted in the USA provided the basis for the generally accepted rule that optimal dental caries protection and minimal dental fluorosis are associated with a drinking water fluoride level of about 1ppm.[38] The World Health Organization and Indian Council of Medical Research described the drinking water quality guideline value for fluoride is 1.5mg/l.[38] The permissible level of fluoride in drinking water as per the BSI(Bureau of Indian standards) is given to

1-1.5 mg/l.[55] As per the report given by TWAD (Tamil Nadu Water and Drainage) Board the acceptable limit for fluoride level in drinking water is 1mg/l and is not acceptable and rejected when it exceeds 1.5 mg/l.[56]

Presence of large amount of fluoride (> 1.5 mg/l) is associated with dental and skeletal fluorosis, while inadequate amount of fluoride (<1.0 mg/l) is associated with dental caries.[57] Concentration between 0.6 to1.2 mg/L is essential to protect teeth decay, while higher concentration (beyond 1.5 mg/L) can cause teeth mottling and still higher concentration of fluoride may lead to different major health hazards.[7] Fluorosis is a disease condition that manifests as dental or skeletal fluorosis or both, resulting from higher intake of fluoride above 1.5ppm.[58]

As per the literatures given above, fluoride levels in drinking water between 1-1.5 ppm seem to be a permissible level in India and also in the state of Tamil Nadu. In Indian context, even in regions with fluoride concentration as low as 0.50 mg/l in drinking water, mild forms of dental fluorosis have been reported.[59] With this in mind, study was designed with three groups that is Group-I (fluoride level in drinking water less than 1ppm), Group–II (fluoride level in drinking water between 1-1.5ppm) and Group–III (fluoride level in drinking water above 1.5ppm).

SOURCE OF DATA

The source of data was primary in nature which included laboratory investigation of drinking water, questionnaire and clinical examination.

STUDY POPULATION

The study population includes 13 to 15 year old school going children attending only Government schools in Melur block of Madurai district.

INCLUSION CRITERIA

- Children who were permanent residents of Melur block right from birth.
- Those children, who used the same source of drinking water from birth till 10 years of life.
- Children who obtained the parent's consent were included.

EXCLUSION CRITERIA

- Children undergoing orthodontic treatment.
- Children with extrinsic stain.
- Children with other tooth developmental defects.
- Children who had restorations on facial surface of teeth, which may hinder in the scoring of dental fluorosis.

ETHICAL CLEARANCE

The nature and purpose of the study was explained to the Institutional Review Board and ethical clearance was obtained (Annexure -I). Informed consent was obtained from the parents of study subjects. (Annexure -II)

OBTAINING APPROVAL FROM THE AUTHORITIES

The list of schools was obtained from Chief Educational Officer. The nature and purpose of the study was explained to the Chief Educational Officer and school authorities (Correspondent, Principal, Headmaster/ Headmistress) and prior permission was obtained to conduct the study in their schools. (Annexure –III)

TRAINING AND CALIBRATION EXERCISES

Training exercises were first carried out in the Department of Public Health Dentistry, Best Dental Science College on the out-patients under the guidance of a trained person. About twenty subjects were examined to assess the consistency of

intra-examiner reproducibility. The agreement for most assessments was expected to be 90%.

PILOT STUDY

A pilot study was done to know the feasibility of the study and to pre-test the questionnaire. The questionnaire clarity and the time necessary for filling it up were traced in the pilot study. A pilot study was carried out with 100 students in group-II (1-1.5ppm) and group III (>1.5 ppm) as they were above the generally accepted optimal level.

SAMPLIE SIZE

Using OpenEpi, Version 3, open source calculator-SSPropor the sample size was calculated, based on the prevalence of the dental fluorosis obtained from the pilot study.

Hypothesized Prevalence in the population (*p*) = 74%
Absolute difference +/- % (*d*) = 7.4%
Design effect (for cluster surveys-*DEFF*) = 2

To calculate the sample size

Sample size $\boldsymbol{n = [DEFF*Np(1-p)]/ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)]}$

By substituting the values of prevalence of dental fluorosis obtained from the pilot study in the above formula, the required sample size was calculated.

Sample Size (*n*) with 95% Confidence Levels is **n = 270.**

Therefore, the final sample size required for the main study was 270 in each groups.

SAMPLING METHODOLOGY

The list of schools present in the areas with different fluoride levels in drinking water (Group–I, Group–II, Group –III) in Melur block, Madurai was obtained. To avoid bias due to socioeconomic status, only government school were considered. Following simple random sampling, students were selected from each school to reach the required sample size in each of three groups (Group –I, Group –II, Group –III).The sampling method was stratified cluster sampling.

COLLECTION OF DATA

A questionnaire was used to interview the study subjects. This was followed by a clinical examination done to record the dental fluorosis and dental caries experience.

1. QUESTIONNAIRE

A closed ended questionnaire was used to interview the study subjects. The questionnaire consisted of demographic information which includes name, age, sex, date of birth, place of birth, location of residence from birth and residential address. The questionnaire consisted of 12 questions which were based on their source of drinking water, consumption of drinking water per day, oral hygiene practices and dietary practices. (Annexure -IV)

2. CLINICAL EXAMINATION

A single examiner, the investigator, carried out the clinical examination of all the study subjects involved in the study under natural light using standardized instruments ADA specification type III examination was followed.

Children were seated comfortably on an ordinary chair and examined within their school using natural light. Oral examinations were conducted using a plain mouth mirror and a CPI probe.

Dental caries experience was assessed using Dentition status and treatment needs based on WHO Oral Health assessment form 1997 and dental fluorosis using Dean's Index modified criteria 1942. (Annexure IV).

Community Fluorosis Index (CFI) [63]

To determine the severity of dental fluorosis as a public health problem, Trendley H. Dean in 1946 devised a method of calculating the prevalence and severity of fluorosis in a group or community which he termed as the Community Fluorosis Index CFI.

On the basis of the number and distribution of the individual scores, a Community Index of Dental Fluorosis, (CFI) can be calculated (Dean 1942) using formula

$$CFI = \frac{\text{Sum of (Number of individual X statistical weights)}}{\text{Number of individuals examined}}$$

RANGE OF SCORES FOR COMMUNITY FLUOROSIS INDEX	PUBLIC HEALTH SIGNIFICANCE
0.0–0.4	Negative
0.4–0.6	Borderline
0.6–1.0	Slight

1.0–2.0	Medium
2.0–3.0	Marked
3.0–5.0	Very marked

STATISTICAL ANALYSIS

The collected data were entered into excel. The entered data were checked for consistency. To analyze the data Statistical Package for Social Sciences (SPSS) version 22 was used. Descriptive statistics like proportions, mean, and standard deviations were calculated. To compare mean values between groups Kruskal-Wallis test and one way ANOVA was applied if the data follows Non-Normal and Normal distribution respectively. To find the relationship between two variables Pearson correlation co-efficient was calculated. The significance level is fixed at 5% level.

FIG 1: WATER SAMPLE COLLECTION AT VILLAGES

FIG 2: COLLECTED WATER SAMPLES

FIG 3: THERMO SCIENTIFIC ORION VERSA STAR – ADVANCED ELECTROCHEMISTRY METER WITH FLUORIDE ION SELECTIVE ELECTRODE BN 9609.

FIG 4: ARMAMENTARIUM FOR CLINICAL EXAMINATION

FIG 5: DATA COLLECTION FROM SCHOOL CHILDREN

FIG 6: VERY MILD DENTAL FLUOROSIS

FIG 7: MILD DENTAL FLUOROSIS

FIG 8: MODERATE DENTAL FLUOROSIS

FIG 9: MODERATE DENTAL FLUOROSIS

A cross sectional study was done to assess the dental fluorosis, dental caries experience and its relation to fluoride in drinking water among school going children of Melur Block, Tamil Nadu. The study consisted of 810 participants.

The study population was primarily categorized into three groups based on the fluoride content in their drinking water. The Group-I included 270 subjects who resided in the area where the fluoride content in their drinking water was less than 1ppm, The Group-II included 270 subjects who resided in the area where the fluoride content in their drinking water was between 1-1.5ppm, The Group - III included 270 subjects who resided in the area where the fluoride content in their drinking water was more than 1.5ppm.

Distribution of study subjects with different levels of fluoride in drinking water- Age wise

The Group-I consisted of 113(41.9 %) of the students belonging to 13 years of age, 78(28.8%) belonging to 14 years of age and 79(29.3%) belonging to 15 years of age. The Group-II consisted of 131(48.5 %) of the students belonging to 13 years of age, 85(31.5%) belonging to 14 years of age and 54(20%) belonging to 15 years of age. The Group-III consisted of 75(27.8 %) of the students belonging to 13 years of age, 127(47%) belonging to 14 years of age and 68(25.4%) belonging to 15 years of age.

Among the total study subjects, 319(39.4%) belong to 13 years of age, 290(35.8%) belong to 14 years of age, and 201(24.8%) belong to 15 years of age. (Table 2)

Distribution of study subjects with different levels of fluoride in drinking water- Sex wise

The Group-I consisted of 176 (65.2%) males and 94 (34.8%) females, the Group-II consisted of 130 (48.1%) males and 140 (51.9%) females, the Group-III consisted of 58 (21.5%) males and 212 (78.5%) females. Among the total study subjects, 364 (44.9%) were males and 446 (51.1%) were females. (Table 3)

Distribution of study subjects according to the responses to the questionnaire

Source of drinking water

When the study subjects were enquired about their source of drinking water, the study subjects in Group–I responded that 258 (95.5%) used bore well, and 12 (4.4%) used shallow well as their source of drinking water. The study subjects in Group -II responded that 245 (90.7%) used bore well and 25 (9.2%) used shallow well as their source of drinking water. The study subjects in Group-III responded that 262 (97%) used bore well and 8 (3%) used shallow well as their source of drinking water. Among the study subjects majority of them used bore well that is 765 (94.4%) and only 45 (5.5%) used shallow well as their source of drinking water. (Table 1)

Water consumption

When the study subjects were questioned about the amount of water consumption per day, in Group-I, less than 2 glasses was consumed by 4 (1.5%), 2-4 glasses was consumed by 25 (9.2%) and more than 4 glasses by 24 (89.3%) of the study subjects. In Group-II, less than 2 glasses was consumed by 11 (2.8%), 2-4 glasses was consumed by 13 (4.8%) and more than 4 glasses by 246 (91.1%) of the study subjects. In Group-III, less than 2 glasses was consumed by 2(0.7%), 2-4 glasses was consumed by 8 (3%) and more than 4 glasses by 260 (96.3%) of the study

subjects. Among the study subjects less than 2 glasses was consumed by 17 (2%), 46 (5.7%) consumed 2-4 glasses of water and majority of them that is 747 (92.2%) of them consumed more than 4 glasses of water. (Table-1)

Oral Hygiene Practices

In Group-I, 245 (90.7%) used tooth brush, 21 (7.8%) used finger and 4 (1.5%) used neem stick to clean their tooth. In Group-II, 253 (93.7%) used tooth brush, 16 (6%) used finger and 1 (0.4%) used neem stick to clean their tooth. In Group-III, 262 (97.8%) used tooth brush, 8 (3%) used finger to clean their tooth. Among the study subjects majority of them, that is 760 (93.8%) used tooth brush and only 45 (5.5%) used finger and 5 (0.61%) used neem stick to clean their tooth surface. (Table-1)

When the study subjects were questioned about their method of brushing their teeth, in Group-I, 220 (81.5%) of the subjects responded that they used horizontal motion, 11 (4.1%) used vertical motion, 5 (1.8%) used circular motion, 19 (7%) used a combination of both horizontal and vertical motion, and 15 (5.5%) used a combination of all three kinds of motion for brushing their teeth. In group-II, 238 (88.1%) of the subjects responded that they used horizontal motion, 19 (7%) used vertical motion, 3 (1.1%) used circular motion, 2 (0.7%) used a combination of both horizontal and vertical motion, 1 (0.4%) used a combination of both vertical and circular motion and 7 (2.6%) used a combination of all three kinds of motion for brushing their teeth. In group-III, 240 (88.9%) of the subjects responded that they used horizontal motion, 6 (2.2%) used vertical motion, 1 (0.4%) used circular motion, 20 (7.4%) used a combination of both horizontal and vertical motion, and 3 (0.9%) used a combination of all three kinds of motion for brushing their teeth. Among the majority of them, that is 698 (86.2%) used horizontal motion, 36 (4.4%) used vertical motion,

9 (1.1%) used circular motion, 41 (5.1%) used combination of horizontal and vertical motion, 1(0.1%) used a combination of both vertical and circular motion and 25 (3.1%) used a combination of all three kinds of motion for brushing their teeth. (Table-1)

When the study subjects were questioned about the material used to clean their teeth, in Group –I, 217 (80.4%) used tooth paste, 51 (18.9%) used tooth powder and 2 (0.7%) used charcoal or brick powder. The study subjects in group-II, responded that 249 (92.2%) used tooth paste, 21 (7.8%) used tooth powder. The study subjects in group -III responded that 252 (93.3%) used tooth paste, 18 (6.7%) used tooth powder. Among the study subjects majority of the study subjects that is 718 (88.6%) used tooth paste, 90 (11.1%) used tooth powder and 2 (0.2%) used charcoal or brick powder. (Table-1)

Study subjects in all the three groups do not have the knowledge of presence of fluoride in their tooth paste or tooth powder. (Table-1)

When study subjects were questioned about their frequency of tooth brushing, the study subjects in group-I responded that 239 (88.5%) brushed once daily, 31 (11.5%) brushed twice daily. The study subjects in group-II responded that 251 (93%) brushed once daily, 19 (9.3%) brushed twice daily. The study subjects in group-III responded that 261 (96.7%) brushed once daily, 9 (3.3%) brushed twice daily. Among total study population majority of them that is 751 (92.7%) brushed once daily, 59 (0.7%) brushed twice daily. (Table-1)

When study subjects were questioned about the age at which they started brushing, the study subjects in group -I responded that 207 (76.7%) started brushing as less than 5 years, 63 (23.3%) started brushing between 5- 10 years. The study

subjects in group -II responded that 185 (68.5%) started brushing as less than 5 years and 85 (31.5%) started brushing between 5- 10 years. The study subjects in group -III responded that 225 (83.3%) started brushing as less than 5 years, 45 (16.7%) started brushing between 5- 10 years. Among the total study population majority of them that is 617 (76.1%) started brushing as less than 5 years, 193 (23.8%) started brushing between 5- 10 years. (Table-1)

Dietary Habits

In Group –I, 42 (15.6%) of the children had the habit of eating sweets once daily, 19 (7%) of the children had them 2-3 times every day, 7 (2.6%) had them more than three times every day, 202 (74.8%) of the children never had the habit of eating sweets daily. In Group –II, 28 (10.4%) of the children had the habit of eating sweets once daily, 30 (11.1%) of the children had them 2-3 times every day, 12 (4.4%) had them more than three times every day, 200 (74.1%) of the children never had the habit of eating sweets daily. In Group –III, 18 (6.7%) of the children had the habit of eating sweets once daily, 252 (93.3%) of the children never had the habit of eating sweets daily. Among the total study population 88 (10.9%) of the children had the habit of eating sweets once daily, 49 (6%) of the children had them 2-3 times every day, 49 (6%) had them more than three times every day, 19 (2.3%) of the children never had the habit of eating sweets daily. (Table-1)

In Group-I, 234 (26.7%) of the study subjects had milk, tea or coffee with sugar every day, 9 (3.3%) of the study subjects had fruit juices with sugar every day, 1 (0.4%) consumed carbonated or bottled drinks every day. In Group- II, 255 (94.4%) of the study subjects had milk, tea or coffee with sugar every day, 8 (3%) of the study subjects had fruit juices with sugar every day. In Group-III, 253 (94%) of the study

subjects had milk, tea or coffee with sugar every day, 4 (1.5%) of the study subjects had fruit juices with sugar every day. Among the total study population majority of them that is 742 (91.6%) had milk, tea or coffee with sugar every day, 21 (2.6%) of the study subjects had fruit juices with sugar every day, 1 (0.1%) consumed carbonated or bottled drinks every day. (Table-1)

In Group-I, 79 (29.2%) of the study subjects had the habit of eating snacks once every day, 13 (4.8%) of the study subjects had snacks 2-3 times a day, 4 (1.5%) of the study subjects had snacks more than 3 times a day while 174 (64.4%) of them never had the habit of having snacks every day. In Group-II, 103 (38.1%) of the study subjects had the habit of eating snacks once every day, 6 (2.2%) of the study subjects had snacks 2-3 times a day, 2 (0.7%) of the study subjects had snacks more than 3 times a day while 159 (59%) of them never had the habit of having snacks every day. In Group-III, 44 (16.3%) of the study subjects had the habit of eating snacks once every day, 226 (83.7%) of them never had the habit of having snacks every day. Among the total study population 226 (27.9%) of the study subjects had the habit of eating snacks once every day, 19 (23%) of the study subjects had snacks 2-3 times a day, 6 (0.7%) of the study subjects had snacks more than 3 times a day and majority of them that is 559 (69%) never had the habit of having snacks every day. (Table-1)

In Group–I, 37 (13.7%) of the study subjects had the habit of mouth rinsing after every meal and every snack, 52 (19.3%) of them after every meal, 18 (6.7%) of them occasionally, 163 (60.4%) of them never had the habit of mouth rinsing. In Group - II, 56 (20.7%) of the study subjects had the habit of mouth rinsing after every meal and every snack, 21 (7.8%) of them after every meal, 70 (25.9%) of them occasionally, 123 (45.5%) had never had the habit of mouth rinsing, In Group–III, 28 (10.4%) of the study subjects had the habit of mouth rinsing after every meal and every snack, 31

(11.4%) of them after every meal, 21 (7.8%) of them occasionally,190 (70.4%) of them never had the habit of mouth rinsing. Among the total study population, 121 (14.9%) of the study subjects had the habit of mouth rinsing after every meal and every snack, 104 (12.8%) of them after every meal, 109 (134%) of them occasionally and 456 (58.7%) of them never had the habit of mouth rinsing. (Table-1)

Fluoride level in drinking water in villages of Melur block

Fluoride concentration in the habitations of Melur block ranged from 0.01 ppm to 2.79 ppm. The fluoride levels of the habitations in Melue block are shown in detail in (Annexure IV & V).

Prevalence of dental fluorosis according to age

A total of 711 (87.7%) of study subjects in the age group of 13 -15 years were affected with dental fluorosis. Among the total study population of 810, 262 (82.1%) of the study subjects in the age group of 13 years were affected with dental fluorosis, 257 (88.6%) of the study subjects in the age group of 14 years were affected with dental fluorosis, 192 (95.5%) of the study subjects in the age group of 15 years were affected with dental fluorosis.(Table 4)

Prevalence of dental fluorosis according to sex

Among the total study population of 810, 711 (87.7%) of the study subjects were affected with dental fluorosis, among which 324 (89%) of the males and 387 (86.7%) of the females were affected with dental fluorosis. (Table 5).

Prevalence of dental caries according to age

A total of 350 (43.2%) of study subjects in the age group of 13 -15 years had dental caries. Among the total study population of 810, 149 (18.4%) of the study

subjects in the age group of 13 years had dental caries, 166 (20.5%) of the study subjects in the age group of 14 years had dental caries, 35 (4.3%) of the study subjects in the age group of 15 years had dental caries. (Table 6)

Prevalence of dental caries according to sex

In the present study there were 460 (56.7%) children who were free from dental caries while the remaining 350 (43.2%) children presented with dental caries experience. Among the study subjects 172 (21.2%) of the males and 178 (22%) of the females had dental caries. (Table 7)

Prevalence and severity of dental fluorosis at different fluoride levels in drinking water

Among the total study population of 810, 217 (80.3%), 242 (8.6%) and 252 (93.3%) of the children were affected with dental fluorosis in Group- I (< 1.0 ppm), Group–II (1.0 - 1.5 ppm) and Group –III (> 1.5ppm) respectively.

Among the total study population of 810, 99 (12.2%) of the subjects was found to be normal, 259 (31.9%) had questionable fluorosis, 118 (14.6%) had very mild fluorosis, 121 (14.3%) had mild fluorosis, 177 (318%) had moderate fluorosis. There was no case identified with severe fluorosis.

In Group–I 53 (19.6%) had no fluorosis, 152 (56.2%) had questionable fluorosis, 34 (12.6%) had very mild fluorosis, 23 (8.5%) had mild fluorosis, 8 (2.1%) had moderate fluorosis. In Group-II 28 (10.4%) had no fluorosis, 84 (31.1%) had questionable fluorosis, 80 (29.6%) had very mild fluorosis, 48 (17.8%) had mild fluorosis, 30 (11.1%) had moderate fluorosis. In Group–III 18 (6.7%) had no fluorosis, 23 (8.5%) had questionable fluorosis, 40 (14.8%) had very mild fluorosis, 50 (18.5%) had mild fluorosis, 139 (51.5%) had moderate fluorosis. The difference noted between

the groups was found to be statistically very highly significant ($p<0.001$). The prevalence and severity of dental fluorosis increased with increasing concentration of fluoride in drinking water. (Table 8 & Graph 1) and Post Hoc analysis was done to compare between group 1, Group2, Group 3 and it was statistically significant (Table 8a).

Community Fluorosis Index score

The Community Fluorosis Index for the entire study population was found to be 2.3 which reveals that dental fluorosis is of marked public health significance in Melur block of Madurai district.

In Group-I the mean CFI was found to be 1.2 which is of medium public health significance. In Group-II the mean CFI was found to be 1.9 which is of medium public health significance. In group–III the mean CFI was found to be 3.1 which is of very marked public health significance. The Community Fluorosis Index score increased with an increasing concentration of fluoride in drinking water. (Table 9)

Relationship between dental fluorosis and fluoride level in drinking water

When the fluoride concentration in drinking water was correlated with CFI score to know the relation between water fluoride concentration and dental fluorosis, a statistically significant positive correlation (Pearson's correlation co-efficient = 0.510, $P<0.000$) was found between mean fluoride concentration and Community Fluorosis Index score. (Table 10)

Prevalence of dental caries experience at different fluoride levels in drinking water

Among the total study population of 810, 350 (43.2%) had dental caries experience.

In Group –I, 185 (68.5%) had dental caries experience, in Group –II, 94 (34.8%) had dental caries experience, in Group –III, 71 (26.3%) had dental caries experience. The difference noted between the groups was found to be statistically significant ($p<0.05$). (Table 11 & Graph 2)

In Group –I the mean DMFT score was found to be 0.90. In Group –II the mean DMFT score was 0.66 and in Group –III the mean DMFT score was found to be 0.37. The difference noted between the groups was found to be statistically significant (Table 12).

The prevalence of caries and the mean DMFT decrease with increase in the fluoride concentrations in drinking water.

Post Hoc analysis was done between Group 1 and Group 2, Group 2 and Group 3 and Group 1 and Group 3 and it was statistically significant (Table 12a).

Relationship between dental caries and fluoride levels in drinking water

When the fluoride concentration in drinking water was correlated with mean DMFT score to know the relation between water fluoride concentration and dental caries, a negative correlation (Pearson's correlation co-efficient = -0.991) was observed between fluoride concentration in drinking water and mean DMFT score. But it was not statistically significant ($p>0.05$) (Table 13).

Relationship between dental fluorosis and dental caries experience

When mean CFI score was correlated with mean DMFT score, negative correlation (Pearson's correlation co-efficient = -0.995) was observed between mean CFI score and mean DMFT score. But it was found to be statistically not significant ($p>0.05$) (Table 14).

TABLE 1: RESPONSES TO QUESTIONNAIRE

Sl.No	Questions	Responses	Group I n (%)	Group II n (%)	Group III n (%)	Total n (%)
1	Source of Drinking water	Bore well	258 (95.5%)	245 (90.7%)	262 97%)	765 (94.4)
		Shallow well	12 (4.4%)	25 (9.25%)	8 (3%)	45 (5.5%)
2	Everyday water consumption	< 2 glasses	4 (1.5%)	11 (4.1%)	2 (0.7%)	17 (2%)
		2-4 glasses	25 (9.2%)	13 (4.8%)	8 (3%)	46 (5.7%)
		> 4 Glasses	241 (89.3%)	246 (91.1%)	260 (96.3%)	747 (92.2%)
3	Cleanliness of teeth	Toothbrush	245 (90.7%)	253 (93.7%)	262 (97%)	760 (93.8%)
		Finger	21 (7.8%)	16 (6%)	8 (3%)	45 (5.5%)
		Neem stick	4 (1.5%)	1 (0.4%)	0	5 (0.61%)
		Others	0	0	0	0
4	Method of Brushing teeth	Horizontal	220 (81.5%)	238 (88.1%)	240 (88.9%)	698 (86.2%)
		Vertical	11 (4.1%)	19 (7%)	6 (2.2%)	36 (4.4%)
		Circular	5 (1.8%)	3 (1.1%)	1 (0.4%)	9 (1.1%)
		A&B	19 (7%)	2 (0.7%)	20 (7.4%)	41 (5.1%)
		B&C	0	1 (0.4%)	0	1 (0.1%)
		A&C	0	0	0	0

		All the above	15 (5.5%)	7 (2.6%)	3 (0.9%)	25 (3.1%)
5	Material used to clean teeth	Toothpaste	217 (80.4%)	249 (92.2%)	252 (93.3%)	718 (88.6%)
		Toothpowder	51 (18.9%)	21 (7.8%)	18 (6.7%)	90 (11.1%)
		Charcoal/brick powder	2 (0.7%)	0	0	2 (0.2%)
		If any other specify	0	0	0	0
6	Knowledge of Fluoride in Toothpaste/ Powder	Yes	0	0	0	0
		No	0	0	0	0
		Sometimes	0	0	0	0
		Don't know	270 (100%)	270 (100%)	270 (100%)	810 (100%)
7	Frequency of Tooth Brushing	Once daily	239 (88.5%)	251 (93%)	261 (96.7%)	751 (92.7%)
		Twice daily	31 (11.5%)	19 (9.3%)	9 (3.3%)	59 (0.7%)
		More than two times daily	0	0	0	0
		Never	0	0	0	0
8	Age at which Brushing of Teeth was Started	< 5 years	207 (76.7%)	185 (68.5%)	225 (83.3%)	617 (76.1%)
		5-10 years	63(23.3%)	85 (31.5%)	45 (16.7%)	193 (23.8%)
		>10 years	0	0	0	0
9	Sweet Consumption Daily	No	202 (74.8%)	200 (74.1%)	252 (93.3%)	654 (80.7%)
		Once	42 (15.6%)	28 (10.4%)	18 (6.7%)	88 (10.9%)

		2-3 times	19 (7%)	30 (11.1%)	0	49 (6%)
		>3 times	7 (2.6%)	12 (4.4%)	0	19 (2.3%)
10	Beverages Consumptions Daily	Milk/tea/coffee	234 (26.7%)	255 (94.4%)	253 (94%)	742 (91.6%)
		Fruit juices	9 (3.3%)	8 (3%)	4 (1.5%)	21 (2.6%)
		Carbonated / bottled drinks	1(0.4%)	0	0	1 (0.1%)
		A&B	22 (8.4%)	6 (2.2%)	6 (2.2%)	34 (4.1%)
		B&C	3 (1.1%)	1 (0.4%)	1 (0.4%)	5 (0.6%)
		A&C	1 (0.4%)	0	0	1 (0.1%)
		All the above	0	0	6 (2.2%)	6 (0.7%)
11	Frequency of Eating snacks Daily	No	174 (64.4%)	159 (59%)	226 (83.7%)	559 (69%)
		Once	79 (29.2%)	103 (38.1%)	44 (16.3%)	226 (27.9%)
		2-3 times	13 (4.8%)	6 (2.2%)	0	19 (2.3%)
		>3 times	4 (1.5%)	2 (0.7%)	0	6 (0.7%)
12	Habit of Mouth Rinsing	After every meal /snack	37 (13.7%)	56 (20.7%)	28 (10.4%)	121 (14.9%)
		After every meal	52 (19.3%)	21 (7.8%)	31 (11.4%)	104 (12.8%)
		Occasionally	18 (6.7%)	70 (25.9%)	21 (7.8%)	109 (13.4%)
		Never	163 (60.4%)	123 (45.5%)	190 (70.4%)	456 (58.7%)

TABLE 2: DISTRIBUTION OF STUDY POPULATION-AGE WISE

Age (years)	Fluoride level							
	Group I < 1.0 ppm		Group II 1.0 - 1.5 ppm		Group III > 1.5 ppm		Total	
	n	%	n	%	n	%	n	%
13	113	41.8	131	48.5	75	27.7	319	39.3
14	78	28.8	85	31.5	127	47.0	290	35.8
15	79	29.4	54	20.0	68	25.1	201	24.9
Total	270	100	270	100	270	100	810	100

TABLE 3: DISTRIBUTION OF STUDY POPULATION - GENDER WISE

Gender	Fluoride level							
	Group I < 1.0 ppm		Group II 1.0 - 1.5 ppm		Group III > 1.5 ppm		Total	
	n	%	n	%	n	%	n	%
Male	176	65.5	130	48.2	58	21.5	364	44.9
Female	94	35.5	140	51.8	212	78.5	446	55.1
Total	270	100	270	100	270	100	810	100

TABLE 4: PREVALENCE OF DENTAL FLUOROSIS – AGE WISE

Age	Total no of children	No of children with dental fluorosis
13 years	319 (39.4%)	262 (82.1%)
14 years	290 (35.8%)	257 (88.6%)
15 years	201 (24.8%)	192 (95.5%)
Total	810 (100%)	711 (87.7%)

TABLE 5: PREVALENCE OF DENTAL FLUOROSIS - GENDER WISE

Gender	Total no of children	No of children with dental fluorosis
Male	364 (45%)	324 (89%)
Female	446 (55%)	387 (86.7%)
Total	810 (100%)	711 (87.7%)

TABLE 6: PREVALENCE OF DENTAL CARIES EXPERIENCE -AGE WISE

Age	Total no of children	No of children with dental caries experience
13 years	319 (39.4%)	149 (18.4%)
14 years	290 (35.8%)	166 (20.5)
15 years	201 (24.8)	35 (4.3%)
Total	810 (100%)	350 (43.2%)

TABLE 7: PREVALENCE OF DENTAL CARIES EXPERIENCE -SEX WISE

Gender	Total no of children	No of children with dental caries experience
Male	364 (45%)	172 (21.2%)
Female	446 (55%)	178 (22%)
Total	810 (100%)	350 (43.2%)

TABLE 8: PREVALENCE AND SEVERITYOF DENTAL FLUOROSIS ACCORDING TO FLUORIDE LEVELS IN DRINKING WATER

		Fluorosis												p -Value
		Normal		Questionable		Very mild		Mild		Moderate		Total		
		n	%	n	%	n	%	n	%	n	%	n	%	
Fluoride level	Group I (<1.0ppm)	53	19.6	152	56.2	34	12.6	23	8.5	8	2.1	217	80.3	0.000*
	Group II (1.0-1.5ppm)	28	10.4	84	31.1	80	29.6	48	17.8	30	11.1	242	89.6	
	Group III (>1.0ppm)	18	6.7	23	8.5	40	14.8	50	18.5	139	51.5	252	93.3	
	Total	99	12.2	259	31.9	118	14.6	121	14.3	177	31.8	711	87.7	

Kruskal Wallis test, statistically significant*

TABLE 8a: POST HOC ANALYSIS:

Groups	p - Value
Group I and Group II	0.000*
Group II and Group III	0.000*
Group I and Group III	0.000*

Mann -Whitney test, Statistically significant*

TABLE 9: CFI SCORE IN DRINKING WATER

Groups	CFI Score
Group I (<1.0 ppm)	1.2
Group II (1.0 – 1.5 ppm)	1.9
Group III (> 1.5 ppm)	3.1

TABLE 10: CORRELATION BETWEEN FLUORIDE LEVELS IN DRINKING WATER AND DENTAL FLUOROSIS

Fluoride level in water (mg/l)	Mean Fluoride level in water (mg/l)	CFI score	r- Value	p - Value
Group I (<1.0 ppm)	0.3	1.2	0.510	0.000*
Group II (1.0 – 1.5 ppm)	1.27	1.9		
Group III (> 1.5 ppm)	2.0	3.1		

Pearson Correlation test, Statistically significant*

TABLE 11: PREVALENCE OF DENTAL CARIES EXPERIENCE ACCORDING TO FLUORIDE LEVELS IN DRINKING WATER

Fluoride level	Dental caries		p - value
	n	%	0.000*
Group I (<1.0 ppm)	185	68.5	
Group II (1.0 – 1.5 ppm)	94	34.8	
Group III (> 1.5 ppm)	71	26.3	

Kruskal Wallis Test, statistically significant test*

TABLE 11a :POST HOC ANALYSIS:

Groups	p - Value
Group I and Group II	0.000*
Group II and Group III	0.032*
Group I and Group III	0.000*

Mann -Whitney test, Statistically significant*

TABLE 12: MEAN CARIES EXPERIENCE ACCORDING TO FLUORIDE LEVELS IN DRINKING WATER

Fluoride level	DMFT		p- value
	Mean	Std.Dev	
Group I	0.90	±0.85	0.000*
Group II	0.66	±0.91	
Group III	0.37	±0.71	

Kruskal Wallis Test, statistically significant test*

TABLE 12a: POST HOC ANALYSIS

Groups	p- value
Group I and II	0.000*
Group II and III	0.000*
Group I and III	0.000*

Mann -Whitney test, Statistically significant*

TABLE 13: CORRELATION BETWEEN FLUORIDE LEVELS IN DRINKING WATER AND DENTAL CARIES

Fluoride level in water	r - value	p - value
Group I (<1.0 ppm)	**-0.991**	0.086*
Group II (1.0 – 1.5 ppm)		
Group III (> 1.5 ppm)		

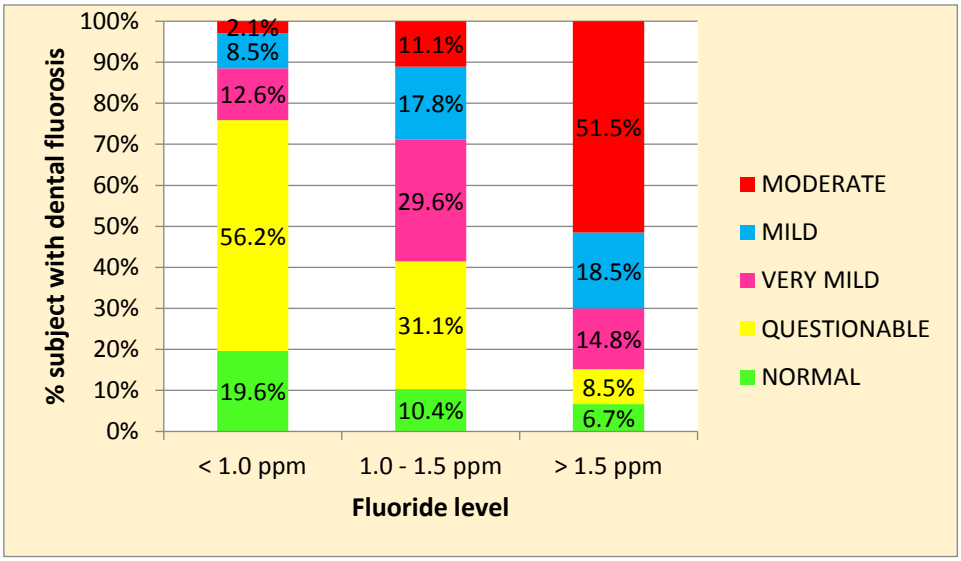
Pearson Correlation test, Statistically not significant*

TABLE 14: CORRELATION BETWEEN CFI AND DENTAL CARIES

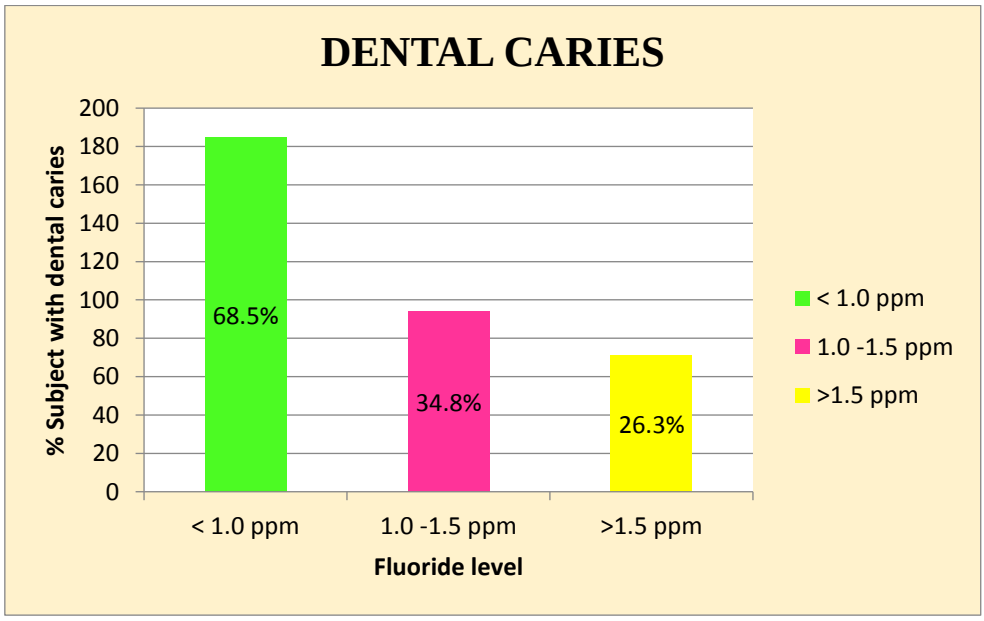
Fluoride level in water	r - value	p - value
Group I (<1.0 ppm)	-0.995	0.063*
Group II (1.0 – 1.5 ppm)		
Group III (> 1.5 ppm)		

Pearson Correlation test, Statistically not significant*

GRAPH 1: PREVALENCE AND SEVERITY OF DENTAL FLUOROSIS ACCORDING TO FLUORIDE LEVELS IN DRINKING WATER



GRAPH 2: PREVALENCE OF DENTAL CARIES ACCORDING TO FLUORIDE LEVELS IN DRINKING WATER



Among all the caries-preventive strategies, discovery of fluoride and its remarkable properties in the prevention of dental caries is a classic example of extensive epidemiological research conducted in various parts of the world. The cariostatic effect of fluoride occurs when fluoride gets incorporated into the enamel during tooth development, whereas dental fluorosis results in the hypo mineralization of tooth enamel due to the continuous ingestion of the excessive amount of fluoride during tooth development. This results in a variety of pathological changes in the structure of teeth. If this is not prevented during childhood it can hamper dental esthetics and psychological well-being of the child. In such scenario dental fluorosis is regarded as an unfortunate side-effect to fluoride's caries-protective benefits.[51] Areas with natural fluoride in the drinking water are natural laboratories where the effect of fluoride can be studied in a real life situation.[38]

Clinical dental fluorosis has been described as the most convenient biomarker of fluoride exposure. It has therefore been advocated that periodic surveys be conducted to monitor the rates of dental fluorosis in communities at risk for the condition.[18]

The estimates of the effects of fluoride on the human dentition can only be obtained when the premolars and the second molars have erupted around the age of 12 -14 years.[61] Hence the present study was conducted among 13-15 year old school children in Melur block of Madurai district.

Responses to questionnaire

Source of drinking water

In the present study among the study subjects majority of them, that is 765 (94.4%) used bore well as their source of drinking water. The results are in agreement with the study conducted by Shanthi M et al (2014)[51] in Nelakondapally mandal of Khammam district where majority of the study subjects(87.3%) used bore well water for drinking purpose.

Result of the present study is higher than the study conducted by Abhay B Mane et al (2011)[40] in Raichur where only 68.6% consumed bore well as their source of drinking water.

Water consumption

In the present study, majority of the study population that is 747(92.2%) of them consumed more than 4 glasses of water. But the finding is in contrast with the studies conducted by Abhay B Mane et al(2011)[40] in Raichur where only 58.2% of the study population consumed (4-6 glasses/day) by Ravi Kiran E et al **(**2012)[45] in Nalgonda district where only 63.6% of the study population consumed (4-6 glasses/day). Increased consumption of water in study population of the present study may be due to hot temperature prevailing in Melur block for most of the months in a year. The consumption of drinking water can vary from individual to individual based on their needs and their physical activities.

Oral hygiene practices

In the present study among the study subjects majority of them, that is 760(93.8%) used tooth brush and only 45(5.5%) used finger and 5(0.61%) used neem stick to clean their tooth surface.

Similarly in a study conducted by Baskaradoss JK et al (2008)[36] in Kanyakumari 84.6% of the children used toothbrushes to clean their tooth surface. The present study is similar to the study conducted by Sumeena et al (2014)[57] in Northern Rural Delhi where 7.7% of the study population used neem stick to clean their tooth surface. But in a study conducted by Pradnya V. Kakodkar (2011)[44] in Amode village of Maharashtra 229 (75.7%) of the study population used finger and 53 (17.49%) used tooth brush to clean their tooth surface. In another study conducted by Ravi Kiran E et al **(**2012)[50] in Nalgonda district 69.0% used neem stick to clean their tooth surface.

In the present study, among the study subjects majority of the study subjects that is 718 (88.6%) used tooth paste, 90 (11.1%) used tooth powder and 2(0.2%) used charcoal or brick powder.

This is similar to the study conducted by Gopalakrishnan et al (1999)[18] in Alappuzha district where 73% of the study population used tooth paste for cleaning the tooth. But in a study conducted by Pradnya V .Kakodkar (2011)[39] in Amode village of Maharashtra 134(44.2%) used tooth powder and 52(17.6%) used tooth paste for cleaning the tooth.

In the present study among total study population majority of them that is 751 (92.7%) brushed once daily, 59 (0.7%) brushed twice daily.

This is similar to the study conducted by Sumeena et al (2014)[52] in Northern Rural Delhi where (77.8%) of the study population brushed once a day and (15.5%) of the study population brushed twice a day.

In a study conducted by Ravi Kiran E et al **(**2012)[45] in Nalgonda district, 92.5% of the study population brushed once daily, in a study conducted by Abhay B Mane et al (2011)[40] in Raichur 89.1% of the study population brushed once daily

and also in another study conducted by Baskaradoss JK et al (2008)[32] in Kanyakumari 80.7% of the study population brushed once daily.

In a study conducted by Pradnya V. Kakodkar (2011)[39] in Amode village of Maharashtra 147 (48.51%) brushed their teeth once daily, 94 (31.02%) brushed twice daily.

Though majority of them used tooth brush and tooth paste to clean their tooth only 0.7% had the habit of brushing twice daily. So it is necessary to educate this study population regarding the proper oral hygiene measures.

Prevalence of Dental fluorosis

In the present study, 711 (87.7%) of 13-15 year old children in Melur block were affected with dental fluorosis. This is similar to study conducted by Shashi A et al (2011)[35] in Punjab where 91.12% of the study subjects were affected with dental fluorosis.

The finding of the present study is higher than the results in a few studies. In a conducted by Chandra Shekar J et al (2002 -2003)[22] in Davangere where only 785 (69.4 %) of 12 – 15 year old children were affected with dental fluorosis and in the study conducted by Shekar C et al (2012)[42] in Nalgonda district where 1656 (71.5%) of 12 and 15 years old children were affected with dental fluorosis. In an another study conducted by Shanthi M et al (2014)[51] in Nelakondapally mandal of Khammam district the prevalence of dental fluorosis among the study population of 9-10 years was found to be 74.8%. In a study conducted by Baskaradoss JK et al (2008)[32] in Kanyakumarithe overall prevalence of dental fluorosis among the study population of 11-15 years was found to be 15.8%. In a study conducted by

América P. Pontigo-Loyola et al (2008)[30] in Mexico 83.8% of 12- and 15-Year-Olds were affected with dental fluorosis.

The results of the present study was higher than the study conducted by Prabhu et al (2014)[50] in Sriperumbudur taluk of Kanchipuram district where only 327 (45.86%) of 12-15 year old school children were affected with dental fluorosis. The increased prevalence of dental fluorosis in the present study may also be attributed to the increased fluoride concentration in drinking water in Melur block which ranges from 0.01 ppm to 2.79 ppm compared to low fluoride concentration of (0.26 to 0.86 mg/l) in Sriperumbudur taluk, in the study conducted by Prabhu et al. In endemic fluorosis area, a great amount of fluoride is incorporated into food materials and ingested into the body. Higher temperatures of Melur, which necessitates greater intake of water, could also be one reason.

In the present study 324 (40%) males and 387 (47.7%) females were affected with dental fluorosis in Melur block.

The results of the present study show that females have a higher prevalence of dental fluorosis than males. In a study conducted by Chandra Shekar J et al (2002 -2003)[22] 442 (69.5%) males and 343 (69.3%) females were affected with dental fluorosis in Davangere, in a study conducted by Shekar C et al (2012)[42] 834 (72.1%) males and 822 (70.9%) females were affected with dental fluorosis in Nalgonda district.

Prevalence of Dental caries

In the present study the overall prevalence of dental caries in the study population was found to be 350 (43.2%). Result of the present study was higher than the study conducted by Vikas C. Desai et al (2013)[47] in Nalgonda district

where the overall prevalence of dental caries in the study population was found to be 35.2%.

Overall prevalence of dental caries was found to be lower in the present study compared to the studies conducted by Shekar C et al (2012)[42] in Nalgonda district where the prevalence of dental caries among the study population was found to be 1303 (56.3%), in a study conducted by Sukhabogi JR et al (2013)[49] in Nalgonda district where the prevalence of dental caries among the study population was found to be 45.6%.

In the present study 172 (21.2%) males and 178 (22%) females had dental caries experience. Results of the study are similar to the study conducted by Vikas C. Desai et al (2013)[47] in Nalgonda district where 34.85% were males and 35.67% were females. Females had more dental caries experience than males.

In the present study the prevalence of dental caries among 13,14 and 15 years was found to be 149 (18.4%), 166 (20.5%) and 35 (4.3%) respectively. In a study conducted by Vikas C. Desai et al (2013)[52] in Nalgonda district the prevalence of dental caries among 13,14 and15 years was found to be 35.65%, 35.06%, and 34.64% respectively.

Relationship of dental fluorosis with different levels of fluoride in drinking water

In the present study 217(80.3%), 242(89.6%) and 252(93.3%) of the children were affected with dental fluorosis in Group- I (< 1.0ppm), Group–II (1.0 - 1.5ppm) and Group –III (> 1.5ppm) respectively.

The result showed that dental fluorosis increased with increase in the levels of fluoride in drinking water. This result was similar to number of other studies. In a study conducted by Shekar C et al (2012)[42] in Nalgonda district 386(39.7%) were

affected in below optimal fluoride area (< 0.7 ppm), 475(86.8%) were affected in optimal fluoride area (0.7–1.2 ppm), 76(97.4%) were affected in above optimal fluoride area (1.2PPM - 2 ppm), 415(100%) were affected in high fluoride area (2.1–4 ppm) and 304(100%) were affected in very high fluoride area (4.1 ppm and above). In a study conducted by Srinivas et al (2010)[38] in Khammam district where the prevalence of dental fluorosis was 14.2% at 0.8ppm of fluoride concentration in water and 55.18% of children were affected at 2.02ppm. The result of the present is in line with the study conducted by Grobler et al (2001)[20] in South Africa where 47% of the school children were affected with dental fluorosis in Sandriff which had a fluoride concentration of 0.19 ppm fluoride followed by 50% of the children were affected with dental fluorosis in Kuboes which had a fluoride concentration of 0.48 ppm fluoride and finally 95% of the school children were affected with dental fluorosis in Leeu Gamaka which had a fluoride concentration of 3.0 ppm fluoride. Similarly in a study conducted by Wondwossen F et al (2004)[25] in Ethiopia the prevalence of dental fluorosis was 91.8% and 100% in moderate and high fluoride area respectively. This suggests that prevalence of fluorosis increases with increase in the level of fluoride in drinking water.

In a study conducted by Kiran Kumar Dandi et al (2012)[43] in Prakasam district where 89.9% of the surfaces examined were affected with fluorosis among below optimal fluoride areas compared to 89.5% and 91.4% from optimal and above optimal categories respectively.

In a study conducted by Chandrashekar J et al (2002 -2003) in Davengere, there was step wise increase in the prevalence of dental fluorosis with corresponding increase in water fluoride content, 13.2% at 0.22 ppm F to 100% at 3.41 ppm fluoride was found. In a study conducted by Mahantesh et al (2011)[42] in

Hungund taluk of Bagalkot the prevalence of dental fluorosis increased from 7% at 0.136 ppm to 58% at 0.381 ppm and further increased to 100% at 1.36ppm. In a study conducted by Acharya S (2005) in Davangere region the prevalence of dental fluorosis showed an increase from 16% at 0.43 ppm fluoride to 100% at 3.41ppm fluoride.

In the present study, in Group-I (<1.0 ppm) 217(80.3%) of the children were affected with dental fluorosis out of which 152(56.2%) had questionable, 34(12.6%) had very mild, 23(8.5%) had mild and 8(2.1%) had moderate level of fluorosis. In Group–II (1.0- 1.5ppm) 242(8.6%) of the children were affected with dental fluorosis out of which 84(31.1%) had questionable, 80(29.6%) had very mild, 48(17.8%) had mild and 30(11.1%) had moderate level of fluorosis. In Group–III (>1.5ppm) 252(93.3%) of the children were affected with dental fluorosis out of which 23(8.5%) had questionable, 40(14.8%) had very mild, 50(18.5%) had mild and 139(51.5%) had moderate level of fluorosis. The severity of dental fluorosis increased with increasing concentration of fluoride in drinking water.

Similarly in a study conducted by Mahantesh et al (2011)[37] in Hungund taluk Bagalkot, in group–I (0.136ppm) 2(2.1%) had questionable fluorosis, 5(5.2%) had very mild fluorosis, in group–II (0.381 ppm) 13(13.1%) had questionable fluorosis, 13(13.1%) had very mild fluorosis, 23(23.3%) had mild fluorosis, 7(7.1%) had moderate fluorosis, 1(1.0%) had severe fluorosis and group–III (1.36ppm) 27(29%) had moderate fluorosis and 66(71%) severe fluorosis. Thus the present study and the above mentioned other studies shows that a linear dose- response relationship exists between fluoride intake and dental fluorosis and the relationship is such that

even with very low fluoride intakes from water, some degree of fluorosis does occur.

In the present study the Community Fluorosis Index for Melur block was found to be 2.0. Whereas in a study conducted by Sumeena et al (2014)[52] in Northern Rural Delhi, Community fluoride index was found to be 3.5 which are greater than the present study.

In the present study Community Fluorosis Index of Group–I, Group–II and Group–III was found to be 1.2, 1.9 and 3.1 respectively. The Community Fluorosis Index score increased with an increasing concentration of fluoride in drinking water. This was similar to the study conducted by Chandrashekar J et al (2002-2003)[26] in Davangere where the Community Fluorosis Index score increased from 0.10 to 2.47 with corresponding increase in fluoride concentration of drinking water from 0.22 ppm fluoride to 3.41 ppm fluoride. The Community Fluorosis Index score increased with an increasing concentration of fluoride in drinking water.

This is also similar to the study conducted by Shekar C et al (2012)[42] in Nalgonda district where the Community Fluorosis Index score was lowest 0.07 at 0.37 ppm and highest 3.49 at 4.88 ppm. In a study conducted by Acharya S (2005)[32] in Davangere region the Community Fluorosis Index score increased from 0.10 at 0.43 ppm fluoride to 2.10 at 3.41ppm fluoride.

In the present study the correlation between fluoride concentration in drinking water and mean Community Fluorosis Index was found to be a statistically significant with moderate positive correlation (r= 0.510) for the entire study population.

Similar results were seen in other studies also. In a study conducted by Chandra Shekar J et al (2002 -2003)[22] in Davangere a positive linear correlation between fluoride concentration in drinking water and Community Fluorosis Index was observed. Karl Pearson correlation coefficient (r) was 0.99. In a study conducted by Shekar C et al(2012)[42] in Nalgonda a strong positive correlation was found to exist between fluoride concentration and mean Community Fluorosis Index (r= 0.833). In a study conducted by Prabhu et al (2014) in Sriperumbudur taluk a significant positive correlation between the fluoride level in drinking water and dental fluorosis, r = 0.319 was observed.

As the fluoride ion level in drinking water increased there was a significant linear increase in prevalence of dental fluorosis. This could be because, as the concentration of fluoride ion increases the ready availability of considerable amount of fluoride in water increases and could contribute to this observation. Also in endemic fluorosis areas fluoride ion is abundant in soil through which the water flows in. The food grown in such areas also carry high amounts of fluoride. These factors must have enhanced fluoride influence on the tooth structure resulting in severity of fluorosis.[6]

Relationship of dental caries with different levels of fluoride in drinking water

In the present study the prevalence of caries experience (68.5%) and the mean DMFT (0.90 ± 0.85) were highest in the Group- I(<1.0ppm) which had drinking water with low concentrations of fluoride, lower caries prevalence (26.3%) and lower mean DMFT 0.37 ± 0.71. was found at Group–III (>1.5ppm), which had drinking water with higher concentrations of fluoride. The results of the present study showed that the prevalence of caries and the mean DMFT increased

with increase in the fluoride concentrations in drinking water though statistically significant.

Similar results were also seen in other studies. In a study conducted by Prabhu et al (2014)[50] in Sriperumbudur taluk where the mean DMFT of the study population was 0.65 ± 0.95 at fluoride level in drinking water ranging from 0.0 to 0.5 mg/l and 0.44 ± 0.90 at fluoride level in drinking water ranging from 0.51 to 1.0 mg/l. Mean DMFT decreased when fluoride concentration in drinking water increased and showed significant difference in the mean DMFT score with varying fluoride ion concentration in drinking water. In another study conducted by Ankur Jain et al (2012)[44] in Lucknow district of Uttar Pradesh where the mean DMFT score (2.21± 0.55) was highest in group A (0.4 ppm) followed by the second highest mean DMFT score (0.96±0.35) in group B (1.03 ppm) and the least mean DMFT score (0.78± 0.22) was observed in group C (2.65 ppm). In a study conducted by Acharya S (2005)[30] in Davangere region mean DMFS decreased from 1.56±1.98 at 0.43ppm to 0.74±1.39 at 3.41 ppm. The above have shown that dental caries has a declining trend with increasing level of fluoride in drinking water.

The findings of the present study are in contrast to few studies, In a study conducted by Srinivas et al (2010)[34] in Khammam where the prevalence of caries (24.4%) and the mean DMFT (0.4) were least in low fluoride area (0.8ppm) and the highest caries prevalence (43.1%) and mean DMFT(1) were found at 2.02 ppm and their differences in dental caries between fluoride groups was also not statistically significant. In an another study conducted by Wondwossenet al (2004)[25] in Ethiopia the prevalence of caries (45.3%) and mean DMFT (1.26±1.98) in moderate fluoride area (0.3 -2.22 mg/l) increased in high fluoride area (10 -14 mg/l) where the caries prevalence and mean DMFT was found to be 61.6% and

1.83± 2.10 respectively which was in line with the present study. In a study conducted by Ranganath et al (2011)[38] mean DMFT of 0.64 ± 1.16 increased from below optimal category(0.7ppm) to a mean DMFT of 0.72 ± 1.17 in optimal category(0.7 -1.2ppm) and highest mean DMFT of 0.75 ± 1.15 was recorded in above optimal fluoride category(>1.2ppm).

In the present study the correlation between fluoride concentration in drinking water and mean DMFT score was found to be a negative correlation (r= -0.991) for the entire study population. But it was not statistically significant.

The findings of the present study are in similar to few studies. In study conducted by Aman Moda et al (2013)[48] in Rewari district of Haryana a statistically significant negative correlation (r = -0.75) was obtained when fluoride in drinking water was correlated with dental caries. In a study conducted by Prabhu et al(2014)[50] in Sriperumbudur taluk significant negative correlation between the fluoride levels in drinking water and prevalence of dental caries, r = - 0.12 was observed. In a study conducted by Acharya S (2005)[26] which shows a highly significant negative correlation (r=-0.16) was found between water fluoride levels and dental caries.

Fluoride is considered to have cariostatic effect in prevent ion of dental caries especially when fluoride gets incorporated into the enamel during tooth development, but in the present study which is considered to be a known fluoride endemic area there was an increase in dental caries experience. The possible reason may be due to the poor oral hygiene habits where majority of the study subjects brushed their tooth only once daily and nearly 58% of the study subjects never had the habit of mouth rinsing.

Relationship between dental fluorosis and dental caries

In the present study, in Group –I, the CFI was found to be 1.2 and the mean DMFT was found to be 0.90 ±0.85. In Group II, the CFI was found to be 1.9 and the mean DMFT was found to be 0.66±0.91. In Group – III, the CFI was found to be 3.1 and mean DMFT was found to be 0.37±0.71. The mean DMFT was found to decrease with the increase in CFI score.

The finding of the present study is similar with the study conducted by Ankur Jain et al (2012)[44] in Lucknow where in group - A (0.4 ppm), the mean CFI was found to be 0 and the mean DMFT was found to be 2.21 ± 0.55. In group –B (1.1 ppm), the mean CFI was found to be 0.02 ± 0.223 and the mean DMFT was found to be 0.96 ± 0.35.In group –C (2.65 ppm), the mean CFI was found to be 0.36 ± 0.973 and the mean DMFT was found to be 0.78 ± 0.22.

Limitations

- As this study is a cross-sectional study, the exact amount of fluoride exposure i.e., the fluoride content of drinking water consumed during the time of calcification of teeth cannot be measured now. It is presumed that water sources are constant and that the fluoride content has not changed over the last 15 years.
- An error might have been incorporated by recall bias of the subjects regarding the continuous use of a same source of water over the past 12 years. The observations made in this study have been confounded by the use of other sources of fluoride exposure which were not measured in this study. This has to be tolerated as fluoride in drinking water was considered to be the main background variable in this study.

- Water samples for fluoride analysis should have been collected from all the villages in three different climatic conditions and average should be taken to exactly compare the effects of fluoride on dentition. Due to practical difficulty in collection of water in villages due to various reasons (such as power shutdown) had prevented from collecting water samples in different climatic condition.

  So further studies are required to analyze the other sources of fluoride exposure such as food, medication, cosmetics and also the industrial exposure of fluoride, which may help us to understand the relationship between fluoride and dental fluorosis in a better manner.

A cross sectional study was carried out among 13-15 year old school going children of Melur block of Madurai district, to assess the prevalence of dental fluorosis, dental caries experience and its relation to level of fluoride in drinking water. Based on the fluoride content in their drinking water the study population was primarily categorized into three groups Group- I (fluoride level in drinking water less than 1ppm), Group –II (fluoride level in drinking water between 1-1.5ppm) and Group –III (fluoride level in drinking water above 1.5 ppm). A total of 810 students with 270 students in each group were selected randomly.

Majority of the study population 765 (94.4%) in the villages of Melur block consumes bore well as their source of drinking water. Majority of the study population 747 (92.2%) consumed more than 4 glasses of water. Among total study population majority of them brushed only once daily that is 751 (92.7%) and 456 (58.7%) never had the habit of mouth rinsing.

The prevalence of dental fluorosis was 87.7% (n=711) in this study among which 324 (89%) of the males and 387 (86.7%) of the females were affected. 262 (82.1%), 257 (88.6%) and 192 (95.5%) of the study subjects in the age group of 13 years, 14 years and 15 years were affected with dental fluorosis, respectively.

Among the study subjects, 350 (43.2%) children presented with dental caries experience out of which 172 (21.2%) of the males and 178 (22%) of the females had dental caries. 149 (18.4%),166 (20.5%) and 35 (4.3%) of the study subjects in the age group of 13 years,14 years and 15 years had dental caries, respectively.

Prevalence and severity of dental fluorosis increased from Group–I to Group–III with increase in fluoride concentration of drinking water from below 1 ppm to above 1.5 ppm. Community Fluorosis Index score was found to increase with increase

in fluoride concentration of drinking water. Community fluorosis index score of Group–I (<1 ppm) and, Group-II (1 .0 -1.5 ppm) is of medium public health significance and Group–III (> 1.5ppm) is of very marked public health significance. The Community Fluorosis Index score of Melur block was found to be of marked public health significance. A significant moderate positive correlation (r= 0.510) was found to exist between fluoride concentration in drinking water and Community Fluorosis Index score.

Prevalence of dental caries and mean DMFT was found to decrease with increase in fluoride concentration of drinking water. A negative correlation (r= -0.991) was found to exist between fluoride concentration in drinking water and dental caries but not found to be statistically significant.

The mean DMFT and mean CFI score was found to increase with increase in fluoride concentration of drinking water. A negative correlation (r= -0.995) was found to exist between dental fluorosis and dental caries and it was found to be statistically not significant.

The present study showed that there was an increase in dental fluorosis severity and decrease in dental caries experience with increase in fluoride levels in drinking water.

Hence it can be concluded from the present study that for the Melur block of Madurai district it is advisable to have the level of fluoride in drinking water not more than 1-1.5 ppm which is also the generally accepted level for optimum prevention of dental fluorosis. The upper limit of fluoride concentration in drinking water of Melur block was found to be 3.6 ppm, so an early intervention in terms of defluoridation of drinking water and creating awareness regarding dental fluorosis as a primordial

intervention is the need of hour for the future generation in the Melur block of Madurai district.

The chronic adverse effects of fluoride are difficult to be treated or reversed, once established. Therefore, prevention is a method of choice to combat this serious health problem caused by fluoride. The occurrence of fluoride at excessive levels in drinking water is the primary reason for the fluoride-inflicted health hazards. The ultimate goal of prevention is to limit the burden of fluoride in the body to less than what is believed to be toxic, by reducing exposure to the ion[9]. The prevention of fluorosis through management of drinking-water is a difficult task, which requires favourable conditions combining knowledge, motivation, prioritization, discipline, technical and organizational support.[62]

Fluoride poisoning which can result in dental fluorosis can be prevented or minimized:[7, 9]

(i) By using alternative water sources.

(ii) By removing excessive fluoride from drinking water.

(iii) By avoiding fluoride rich items.

(iv) By improving the nutritional status of populations at risk.

(v) Health education.

(vi) Prevention of industrial fluorosis by rigorous enforcement of procedures for minimizing industrial fluoride pollution.

1. ALTERNATIVE WATER SOURCES:

The first choice should be to search for water with a lower fluoride level.

Various options are:

a. Provision of a new and alternate source of water with acceptable fluoride levels

b. Transporting water from a distant source

c. Blending high fluoride with low fluoride water

d. Dual water sources (If there are sources with both high and low fluoride levels available to the same community, the source having low fluoride levels can be strictly limited to drinking and cooking. The water source with high fluoride can then be used for other purposes.)[70]

e. Rainwater harvesting

f. Surface water[7]

g. Provision of bottled water[3]

2. BY REMOVING EXCESSIVE FLUORIDE FROM DRINKING WATER

DEFLUORIDATION OF WATER

Domestic defluoridation units using Nalgonda technique or activated alumina can be used by the people in these villages as they are cost-effective.

Community defluoridation tanks can be installed by the government in these villages using Nalgonda technique or activated alumina to provide safe drinking water to the people.[7, 9]

3. BY AVOIDING FLUORIDE RICH ITEMS

Avoid fluoride rich items such as

- Black tea (tea without milk)
- Black salt (Kalanamak)
- Rock salt
- Salted snacks smeared with black salt
- Pickles smeared with black salt
- Masala's smeared with black salt.[65]

4. BY IMPROVING THE NUTRITIONAL STATUS OF POPULATIONS

The use of certain food substances which are rich in few nutrients that reduce the adverse effect of fluoride is highly promoted. Among the nutrients, calcium and magnesium are well known to reduce the blood levels of fluoride and thus its biological effects. Among the commonly available food items, milk and milk products have relatively high calcium contents while magnesium is present in significant amounts in different types of cabbages.

Nutritive foods which are rich in high calcium content, vitamin C, D and E and other antioxidant rich diet should be consumed.

5. HEALTH EDUCATION

Creating awareness about the disease

Creating awareness about fluorosis is vital to combat the condition. The awareness should not be limited to the people affected but should also be extended to all those related to them and others who have something to do with fluoride, including professionals and policy makers.

The main area of interest will be:

a. Creating disease awareness.

b. Creating awareness about the sources of the fluoride.[66]

Current standards of water fluoride levels may have stood since the time of Dean. Many things have changed since then and there is perhaps a need to redefine the standards. As stated by Leverett "we need to acknowledge that fluoride is no different from many other chemicals deliberately introduced into our environment, in a sense that we should strive to maintain the lowest level capable of producing the desired therapeutic effect".[43]

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ANNEXURE - I

INSTITUTIONAL ETHICAL COMMITTEE

Best Dental Science College and Hospital
Ultra Nagar, Madurai - 625 104.
RECOGNIZED BY DENTAL COUNCIL OF INDIA, NEW DELHI
AFFLIATED TO THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI)

CHAIRPERSON

Dr. S. Jayachandran, MDS, Ph.D, MAMS, MBA

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Dr. Bharathkumar, MDS

Dr. P. Hemalatha, MDS

Dr. C.R. Murali, MDS

Prof. Mr. M. Pandi Kumar

Mr. V. Chinnakaruppian, MA BL. DCFSc

MEMBER SECRETARY

Dr. Sudarshan.R, MDS

IRB/IEC Reference No: 2016-STU-BrVII-SBA-10

Project title: Prevalence of Dental flourosis and Dental caries in relation to fluoride in drinking water among 13-15 year old school going children of Melur Block, Madurai district

Principal Investigator: Dr. Prathap.R, PG student

Review: New/Revised/Expedited

Date of Review: 27/09/2016

Date of previous review, if revised application:

Decision of the IEC/IRB:

- Provisional approval to conduct the study is being given
- The results of this study, along with summary are to be submitted for obtaining final approval

Recommended time period: one year (28-09-17)

INSTITUTIONAL REVIEW BOARD SIGN. DATE BDSC

Sudarshan.R

Signature of Member Secretary

PRINCIPAL
BEST DENTAL SCIENCE COLLEGE
MADURAI-625104

NB:

- Inform IRB/IEC immediately in case of any issue(s)/adverse events
- Inform IRB/IEC in case of any change of study procedure, site and investigator
- This permission is only for the period mentioned above
- Annual report to be submitted to IEC/IRB
- Members of IEC/IRB have right to monitor the trail with prior intimation

ANNEXURE – II

BEST DENTAL SCIENCE COLLEGE, MADURAI
DEPARTMENT OF PUBLIC HEALTH DENTISTRY

INFORMED CONSENT

Research on: Prevalence of dental fluorosis and dental caries in relation to fluoride in drinking water among 13-15 year old school going children of Melur block, Madurai district, Tamilnadu.

Dear parent/guardian

The study in which your child is about to participate is " Prevalence of dental fluorosis and dental caries in relation to fluoride in drinking water among 13-15 year old school going children of Melur block, Madurai district, Tamilnadu". It is being conducted by **Dr. R. Prathap** (Post Graduate Student, Department of Public Health Dentistry).

The study involves

- Filling up of questionnaire which consists of questions related to source of drinking water, water consumption, oral hygiene practices and dietary practices.
- Clinical examination to assess Dental fluorosis and Dental caries experience.

In general there will be no side effects, as the study group will not be asked to take or given any drugs.

Please be assured that any information that you provide will be held in strict confidence by the researchers. At no time will your name be reported along with your responses. All data will be reported in group form only.

Please understand that your child's participation in this research is totally voluntary and you are free to withdraw during this study without penalty and to remove any data that you may have contributed.

I acknowledge that I have been informed of and understand the nature and purpose of this study and I freely consent to my child's participation.

Sign Date

CONSENT FORM

I have fully understood the procedure and I, hereby give my unconditional consent for the participation of my child/ward .....in the above mentioned project to be conducted in the school.

Address &Phone No:

Signature
(Parent/Guardian)

பெஸ்ட் பல் மருத்துவ கல்லூரி மற்றும் மருத்துவமனை, மதுரை

பல் மருத்துவ பரிசோதனை செய்ய ஒப்புதல் பத்திரம்

தகவல் தெரிவிக்க அனுமதிக்கப்பட்ட
முகவரின் / நபரின் பெயர் மற்றும் முகவரி : Dr.இரா.பிரதாப்
63/B, ஞான வினாயகர் கோயில் தெரு,
காட்டுமன்னார் கோயில்,
கடலூர் மாவட்டம் -608301.

தகவல் தெரிவிக்கும் நபர் அல்லது
அமைப்பின் பெயர் மற்றும் முகவரி : பெஸ்ட் பல் மருத்துவ கல்லூரி மற்றும் மருத்துவமனை, மதுரை.

ஆய்வுக்கு உட்படுத்தப்படும் நபரின்
பெயர் மற்றும் முகவரி :

நாங்கள் 13-15 வயது பள்ளி மாணவர்களுக்கு பற்சொத்தை, பல் ப்ளூரோஸிஸ் மற்றம் குடிநீரில் உள்ள ப்ளூரைடு கனிமம் உடனான தொடர்பு பற்றிய ஆய்வினை மேலூர் தாலுகா, மதுரை மாவட்டத்தில் நடத்த விழைகிறோம். இதற்காக தங்களின் மகன் / மகளிடம் வாய் நலப் பரிசோதனை செய்ய உள்ளோம். இந்த பரிசோதனை செய்ய ஒரு நபருக்கு 5 நமிடங்கள் ஆகும். இதற்காக தங்களின் மேலான சம்மதத்தை எதிர்நோக்குகின்றோம்.

நான் _____ இதன் மூலம் தெரிவிப்பது என்னவென்றால் என் மகன்/ மகளின் பற்களின் பரிசோதனை பற்றிய முழு விவரமும் எனக்கு எடுத்துரைக்கப்பட்டது. இது சம்மந்தப்பட்ட ஆய்வு அறிக்கை மேற்கறிப்பிட்ட நபரோ அல்லது அமைப்போ பயன்படுத்த நான் மனப்பூர்வமாக சம்மதிக்கிறேன்.

பெற்றோரின் கையொப்பம் : தேதி :

பள்ளி ஆசிரியர் கையொப்பம் : தேதி :

நான் குழந்தைகளின் பெற்றோர், பள்ளி முதல்வர் மற்றும் ஆசிரியர்களிடம் இந்த ஆய்வு குறித்த அவர்களின் சந்தேகங்களுக்கு தகுந்த விளக்கங்களை தெரிவித்துள்ளேன்.

ஆய்வு மேற்கொள்ளும் மருத்துவரின் கையாப்பம்: தேதி :

ANNEXURE –III

மதுரை மாவட்ட முதன்மைக் கல்வி அலுவலரின் செயல்முறைகள்

ந.க.எண். 1 /PC/2017 நாள்.29.08.2017

பொருள் : மதுரை மாவட்டத்தில் செயல்பட்டு வரும் Best Dental Science College – முதுகலை படித்து வரும் Dr.R.பிரதாப் என்பார் - மேலூர் கல்வி மாவட்டத்திலுள்ள அரசு உயர் /மேல்நிலை பள்ளிகளில் படிக்கும் மாணவ மாணவியர்களுக்கு – வாய் நலப் பரிசோதனை செய்தல் - அனுமதி வழங்குதல் –சார்பு.

பார்வை : Best Dental Science கல்லூரி, மதுரை -104. முதல்வரின் 10.08.2017 நாளிட்ட விண்ணப்பக் கடிதம்.

- - - - -

பார்வையில் காணும் விண்ணப்பத்திற்கு இணங்க மேலூர் கல்வி மாவட்டத்தில் இயங்கும் அரசு உயர்நிலை /மேல்நிலை பள்ளிகளில் படிக்கும் 8, 9 மற்றும் 10ம் வகுப்பு மாணவ மாணவியர்களுக்கு பற்சொத்தை பல் ப்ருரோஸிஸ் மற்றும் குடிநீரிலுள்ள ப்ளுரைடு கனிமம் உடனான தொடர்பு பற்றி ஆய்வினை செய்யும் பொருட்டு Dr.பிரதாப் அவர்களுக்கு பின்வரும் நிபந்தனையின் பேரில் 01.09.2017 முதல் 25.12.2017 வரை அனுமதி வழங்கப்படுகிறது.

1. தலைமை ஆசிரியரிடம் கலந்தாலோசித்து அவர்கள் ஒதுக்கீடு செய்யும் நேரத்தில் மட்டுமே மாணவர்களுக்கான வாய்நலப் பரிசோதனை செய்ய வேண்டும்.
2. பள்ளி செயல்பாட்டிற்கு எவ்வித இடையூறும் ஏற்படக்கூடாது.
3. மாணவ மாணவியர்களின் சம்மதம் பெற்றே சோதனை மேற்கொள்ளப்பட வேண்டும்.
4. மாணவ மாணவியர்களின் கற்றல், கற்பித்தல் பணிக்கு எவ்வித இடையூறும் ஏற்படக்கூடாது.

29/8/17

முதன்மைக் கல்வி அலுவலர்,
மதுரை.

பெறுநர்:

Dr.R.பிரதாப், முதுகலை மாணவர்,
Best Dental Science College. மதுரை.

நகல்

1. மேலூர் கல்வி மாவட்ட அரசுப் பள்ளி தலைமையாசிரியர்கள்.
2. மாவட்டக் கல்வி அலுவலர், மேலூர்.

முதன்மைக் கல்வி அலுவலகம்
29 AUG 2017
மதுரை-625 002

ANNEXURE –IV

RESEARCH TITLE: Prevalence of dental fluorosis and dental caries in relation to fluoride in drinking water among 13-15 year old school going children of Melur Block,Madurai district.

QUESTIONNAIRE AND ORAL EXAMINATION FORM

General Information

SL. No: Student Name:

Students Age: Class & Sec:

Name of the school:

Examination Date: Date of Birth:

Sex: Male ☐ Female ☐

Place/ Location of living from infancy to till date:

Melur Block ☐ Others ☐

Name of the Village:

Address of Residence:

Phone Number:

1. What is generally the Source of your drinking water?

   a. Bore well

   b. Shallow well

   c. Any others

2. How much water do you consume every day?

   a. Less than 2 glasses

   b. 2-4 glasses

   c. More than 4 glasses

3. How do you clean your teeth?

   a. Toothbrush

   b. Finger

   c. Neem stick

   d. Others

4. Which method you follow for brushing teeth?

   a. Horizontal

   b. Vertical

   c. Circular

   d. All of the above

   1. a 2. b 3. C 4. a & b 5. b & c 6. a & c 7. d

5. Which one of the following material do you use to clean your teeth?

   a. Toothpaste

   b. Toothpowder

   c. Charcoal / Brick powder

   d. If any other specify

6. Does your toothpaste / powder contains fluoride?

   a. Yes

   b. No

   c. Some times

   d. Don't know

7. How many times do you brush your teeth?

   a. Once daily

   b. Twice daily

c. More than two times daily

d. Never

8. From which age did you start tooth brushing?

a. Less than 5 years

b. 5-10 years

c. More than 10 years

9. How often do you eat sweets daily? (Chocolates / Ladoos / Cakes/ ice creams / burfi, etc)

a. No

b. Once

c. 2 - 3 times

d. More than 3 times

10. What are the liquids apart from water that you consume frequently everyday?

a. Milk, Tea or Coffee with sugar

b. Fruit juices with sugar

c. Carbonated / bottled drinks

d. If any other specify

1. a 2. b 3. c 4. a & b 5. b & c 6. a & c 7. a, b & c

11. How frequently do you eat snacks daily (in between meals)? (Chips / Samosa / Puffs, etc)

a. No

b. Once

c. 2 - 3 times

d. More than 3 times

12. Do you have the habit of mouth rinsing?

a. After every meal and every snack

b. After every meal

c. Occasionally

d. Never

Oral examination:

Deans Fluorosis Index Modified 1942:

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

Fluorosis score: ☐

Dentition Status and Treatment Need

		55	54	53	52	51	61	62	63	64	65		
		18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28		
Crown	(66)																	(81)	
Root	(82)																	(97)	
Treatment	(98)																	(113)	

		85	84	83	82	81	71	72	73	74	75		
		48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38		
Crown	(114)																	(129)	
Root	(130)																	(145)	
Treatment	(146)																	(161)	

Primary teeth	Permanent teeth			
Crown	*Crown/Root*		STATUS	TREATMENT
A	0	0	Sound	0 = None
B	1	1	Decayed	P = Preventive, caries-arresting care
C	2	2	Filled, with decay	
D	3	3	Filled, no decay	F = Fissure sealant
E	4	—	Missing, as a result of caries	1 = One surface filling 2 = Two or more surface fillings
—	5	—	Missing, any other reason	3 = Crown for any reason
F	6	—	Fissure sealant	4 = Veneer or laminate
G	7	7	Bridge abutment, special crown or veneer/implant	5 = Pulp care and restoration 6 = Extraction
—	8	8	Unerupted tooth, (crown)/unexposed root	7 = Need for other care (specify)..... 8 = Need for other care (specify).....
T	T	—	Trauma (fracture)	
—	9	9	Not recorded	9 = Not recorded

DT ☐ MT ☐ FT ☐ TOTAL DMFT SCORE ☐

ANNEXURE –V

THE GANDHIGRAM RURAL INSTITUTE – DEEMED UNIVERSITY
GANDHIGRAM – 624 302 –DINDIGUL DISTRICT – TAMILNADU
(Ministry of Human Resource Development, Govt. of India)
Accredited By NAAC with 'A' Grade (3RD Cycle)
DEPARTMENT OF CHEMISTRY

Dr.S.Meenakshi
Professor & Head

Ph:0451 -2452371 **Mobile: +91 9443838121** **Email: drmeenakshi@gmail.com**

TO 07.08.2017

Dr.R.Prathap,

Post graduate student,

Department of Public Health Dentistry,

Best Dental Science College & Hospital,

Madurai – 625104.

FLUORIDE ESTIMATION RESULTS

SL.NO	SAMPLES NUMBER	VILLAGE NAME	CONCENTRATION FLUORIDE IN PPM
1	Sample - 1	Amoor	0.07
2	Sample – 2	Maruthur	0.03
3	Sample – 3	Mukkampatti	0.04
4	Sample – 4	Thiruvathavur	0.36
5	Sample – 5	Arittapatti	0.23
6	Sample – 6	Kidaripatti	0.04
7	Sample – 7	A.Valayapatti	0.01
8	Sample – 8	Soorakundu	0.04
9	Sample – 9	Therkutheru	0.03
10	Sample – 10	Narasingampatti	0.47
11	Sample – 11	Maruthur	0.16
12	Sample – 12	T.Manickampatti	0.59
13	Sample – 13	Perungalakudi	1.35
14	Sample – 14	Kottakudi	0.43
15	Sample – 15	T.Kottai	0.30
16	Sample – 16	Muthanpatti	0.17
17	Sample – 17	T.Ulagupichanpatti	1.48
18	Sample – 18	Samathuvapuram	0.13
19	Sample – 19	Therkamur	1.17

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20	Sample – 20	Menakshipuram	0.28
21	Sample – 21	Poonjuthi	0.62
22	Sample – 22	Sunnambur	0.32
23	Sample – 23	Keeranur	0.29
24	Sample – 24	K.Valayarpatti	0.58
25	Sample – 25	Arasappanpatti	1.20
26	Sample – 26	Katharasapatti	1.44
27	Sample – 27	T.Palayur	0.28
28	Sample – 28	Sundarajanpatti	1.44
29	Sample – 29	Alagarkoil	0.36
30	Sample – 30	Ayuthampatti	0.13
31	Sample – 31	Alagapuri	1.42
32	Sample – 32	Elamanayagapuram	0.27
33	Sample – 33	Perumalpatti	1.49
34	Sample – 34	Kalungupatti	0.30
35	Sample – 35	Poosaripatti	0.08
36	Sample – 36	Muthupatti	1.71
37	Sample – 37	Koothappanpatti	0.12
38	Sample – 38	Navinipatti	0.36
39	Sample – 39	N.Kovilpatti	0.43
40	Sample – 40	Keelayur	0.27
41	Sample – 41	Kilaviparaipatti	1.22
42	Sample – 42	Rengasamypuram	1.15
43	Sample – 43	Pattiadikkanpatti	0.11
44	Sample – 44	Keelavalavu	1.25
45	Sample – 45	Jothinagar	0.16
46	Sample – 46	Ammankoilpatti	0.19
47	Sample – 47	Vatchampatti	0.10
48	Sample – 48	Kambarmaaipatti	0.29
49	Sample – 49	Malampatti	0.28
50	Sample – 50	Kongampatti	1.20
51	Sample – 51	Kariyapatti	0.22
52	Sample – 52	Kayampatti	1.34
53	Sample – 53	Neikarakudipatti	0.21
54	Sample - 54	Sumathipuram	0.19
55	Sample - 55	Semminipatti	0.14
56	Sample – 56	Muthusamypatti	0.14

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57	Sample – 57	Illuppapatti	0.52
58	Sample – 58	Ayyanar colony	0.15
59	Sample – 59	Muthuramalingapatti	1.29
60	Sample – 60	S.Alagapuri	0.32
61	Sample – 61	Santhamangalam	1.24
62	Sample – 62	Nadupatti	0.31
63	Sample – 63	Meenakshipuam	1.31
64	Sample – 64	Vannamparaipatti	1.12
65	Sample – 65	Ganapathipuram	2.23
66	Sample – 66	Ulaganathapuram	0.20
67	Sample – 67	Atukulam	2.19
68	Sample - 68	Sarguvalayapatti	1.78
69	Sample – 69	Thaniyamangalam	0.79
70	Sample – 70	Vellalur	1.82
71	Sample – 71	Arivupatti	1.85
72	Sample – 72	Chathanoor	0.83
73	Sample – 73	Pannagadi	1.26
74	Sample – 74	Subramaniyapuram	0.86
75	Sample - 75	Mukkampatti	0.22
76	Sample - 76	Uranganpatti	1.81
77	Sample - 77	Konarthoppu	0.27
78	Sample – 78	Ambalakarampatti	0.22
79	Sample – 79	Vinayagapuram	1.10
80	Sample – 80	Muruganpatti	1.15
81	Sample – 81	Anna nagar	1.21
82	Sample – 82	Sulthan street	1.18
83	Sample – 83	Vinayga nagar	0.14
84	Sample – 84	Jothinagar	2.15
85	Sample – 85	Lakshmi street	1.39
86	Sample – 86	E.B.Colony	0.38
87	Sample – 87	Konar nagar	0.43
88	Sample – 88	Melur town	0.37
89	Sample – 89	Bypass road	1.22
90	Sample – 90	Krishna nagar	0.17
91	Sample – 91	Bank road	1.88
92	Sample – 92	Kasthuribhai street	1.80
93	Sample – 93	Anna nagar	2.79

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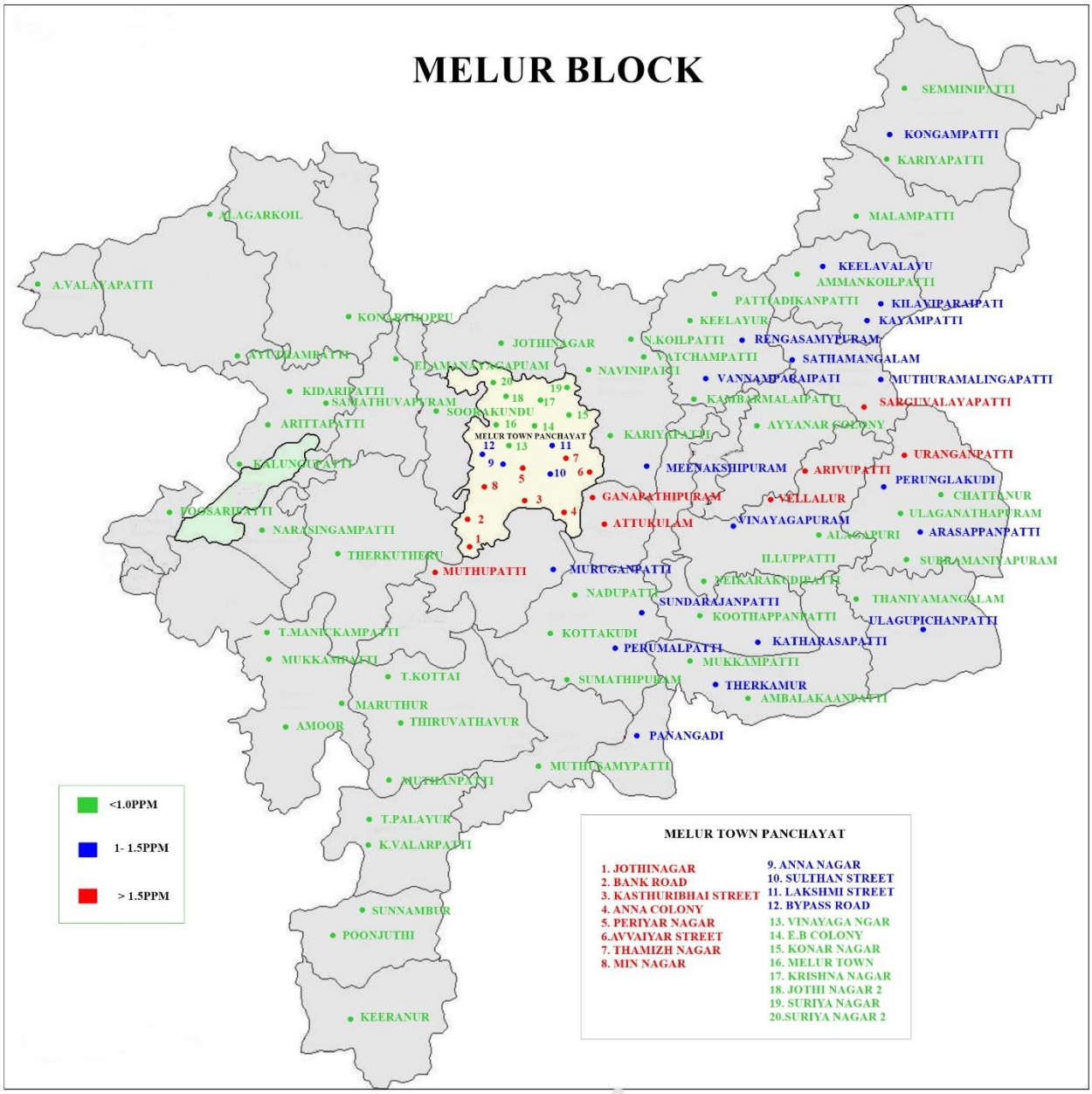
94	Sample – 94	Periyar nagar	1.78
95	Sample – 95	Jothinagar 2	0.80
96	Sample – 96	Avvaiyar street	2.78
97	Sample – 97	Suriya nagar	0.79
98	Sample – 98	Suriya nagar2	0.80
99	Sample – 99	Thamizh nagar	1.67
100	Sample – 100	Min nagar	1.77

NOTE:

- **Fluoride levels in samples was analysed using Thermo Scientific Orion Versa Star – Advanced Electrochemistry meter with Fluoride Ion Selective Electrode BN 9609.**

Dr.S. MEENAKSHI
Professor and Head
Department of Chemistry
Gandhigram Rural Institute (DU)
Gandhigram - 624 302, Tamil Nadu, India.

ANNEXURE –VI


MELUR BLOCK
SEMMINIPATTI
KONGAMPATTI
KARIYAPATTI
MALAMPATTI
KEELAVALAVU
AMMANKOILPATTI
KILAVIPARAIPATI
KAYAMPATTI
RENGASAMYPURAM
SATHAMANGALAM
MUTHURAMALINGAPATTI
SARGIVALAYAPATTI
URANGANPATTI
PERUNGLAKUDI
CHATTANUR
ULAGANATHAPURAM
ARASAPPANPATTI
SUBRAMANIYAPURAM
THANIYAMANGALAM
ULAGUPICHANPATTI
KATHARASAPATTI
THERKAMUR
AMBALAKAANPATTI
PANANGADI
MUTHUSAMYPATTI
PERUMALPATTI
MUKKAMPATTI
SUMATHIPURAM
KOTTAKUDI
KOOTHAPPANPATTI
SUNDARAJANPATTI
NADUPATTI
VELLALUR
VINAYAGAPURAM
ALAGAPURI
ILLUPPATTI
MEENAKSHIPURAM
ARIVUPATTI
GANAPATHIPURAM
ATTUKULAM
MURUGANPATTI
MUTHUPATTI
THERKUTHERU
NARASINGAMPATTI
POOSARIPATTI
KALUNGUPATTI
ARITTAPATTI
KIDARIPATTI
SAMATHUVAPURAM
AYYAMPALAYAM
A.VALAYAPATTI
ALAGARKOIL
KONGARTHOPPU
JOTHINAGAR
ELAMANAYAKAPURAM
SOOLAKUNDU
MELUR TOWN PANCHAYAT
KARIYAPATTI
NAVINIPATTI
N.KOILPATTI
VATCHAMPATTI
VANNAMPARAIPATI
KAMBARMALAIPATTI
AYYANAR COLONY
T.MANICKAMPATTI
MUKKAMPATTI
T.KOTTAI
MARUTHUR
AMOOR
THIRUVATHAVUR
MUTHANPATTI
T.PALAYUR
K.VALARPATTI
SUNNAMBUR
POONJUTHI
KEERANUR
<1.0PPM
1- 1.5PPM
> 1.5PPM
MELUR TOWN PANCHAYAT
1. JOTHINAGAR
2. BANK ROAD
3. KASTHURIBHAI STREET
4. ANNA COLONY
5. PERIYAR NAGAR
6.AVVAIYAR STREET
7. THAMIZH NAGAR
8. MIN NAGAR
9. ANNA NAGAR
10. SULTHAN STREET
11. LAKSHMI STREET
12. BYPASS ROAD
13. VINAYAGA NGAR
14. E.B COLONY
15. KONAR NAGAR
16. MELUR TOWN
17. KRISHNA NAGAR
18. JOTHI NAGAR 2
19. SURIYA NAGAR
20.SURIYA NAGAR 2

ANNEXURE- VII

From

Dr.R.Prathap,
II year Post graduate student,
Department of Public Health Dentistry,
Best Dental Science College,
Madurai.

Through

Dr.Bharathkumar Garla., MDS,
Head of the Department,
Department of Public Health Dentistry,
Best Dental Science College,
Madurai.

21/12/16

DEPT. OF PUBLIC HEALTH DENTISTRY
READER
PUBLIC HEALTH DENTISTRY
MADURAI 625 104.
BEST DENTAL SCIENCE COLLEGE
MADURAI
BEST DENTAL SCIENCE COLLEGE

To

The Principal,
Best Dental Science College,
Madurai.

Respected ~~Sir~~/Madam

Sub: ***Request for Permission to conduct a research in partial fulfillment of the requirement of MDS curriculum.***

With reference to the above subject, I would like to bring to your kind notice that I,Dr.R.Prathap, Second Year Post Graduate In The Department Of Public Health Dentistry, have planned to conduct a research titled "***Prevalence of dental fluorosis and dental caries in relation to fluoride in drinking water among 13-15 year old school going children of Melur taluk, Madurai district*** ". Therefore sir, I kindly request you to grant me permission to conduct this research.

Thanking you,

Date: 21.12.2016

Yours Sincerely,

21/12/16

PRINCIPAL
BEST DENTAL SCIENCE COLLEGE
MADURAI-625104